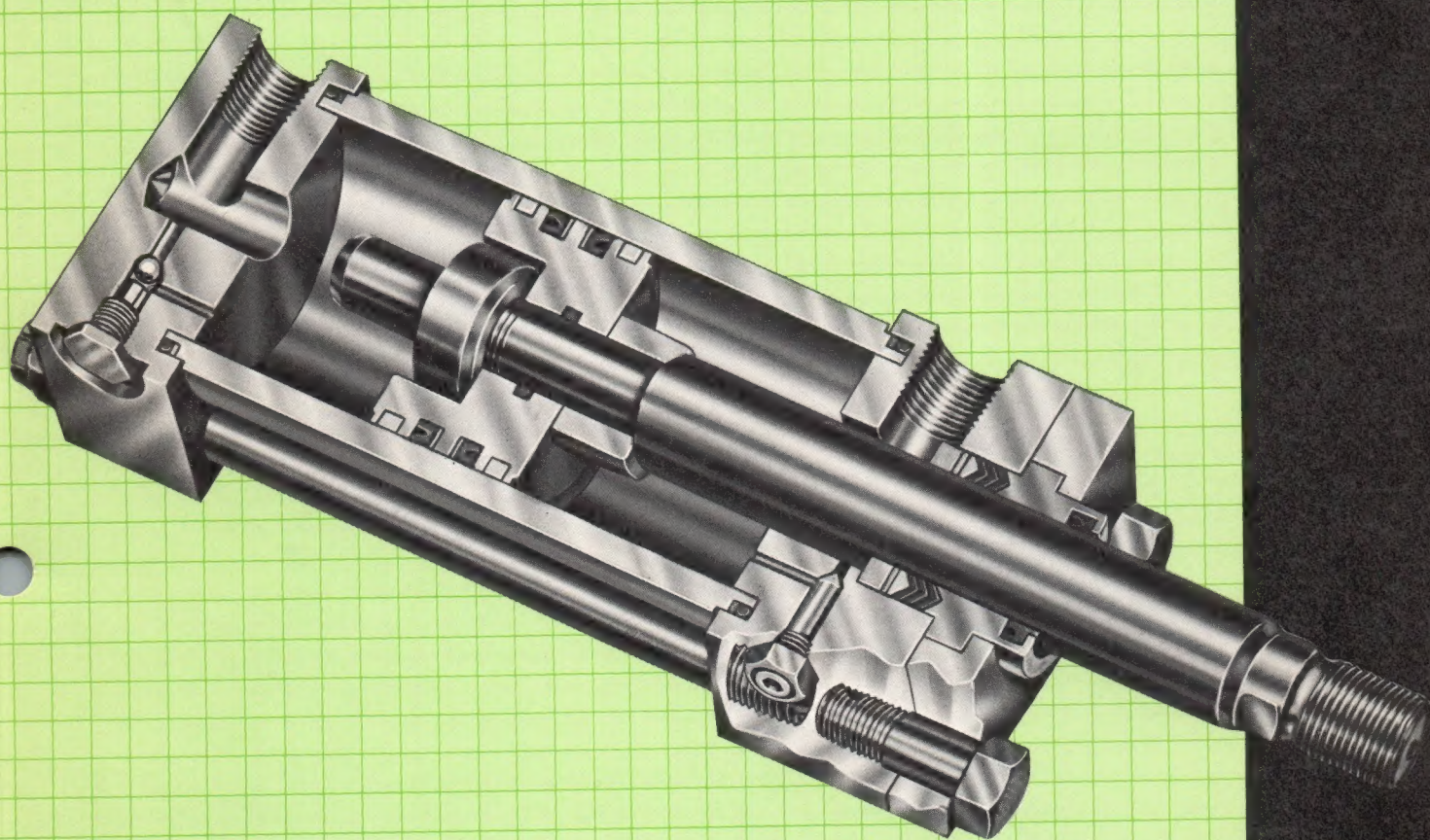


milwaukee
Cylinder
a versa tek company

SERIES H

1½" thru 12" Bore up to 3000 PSI
To 5000 PSI Non-shock (consult factory)



**HYDRAULIC
CYLINDERS**

with Removable Retainers



National
**FLUID
POWER**
Association
MEMBER

How to use this catalog . . .

Before selecting a cylinder, take a few moments to read through this catalog. Pay particular attention to the pages concerning design options and rod size selection.

A Complete Index is shown below; page 3 offers a Quick Index. The Complete Index is divided into sections according to subject with a brief description and the associated page number. The Quick Index illustrates the standard available mountings with the number of the page containing dimensional data.

Complete index

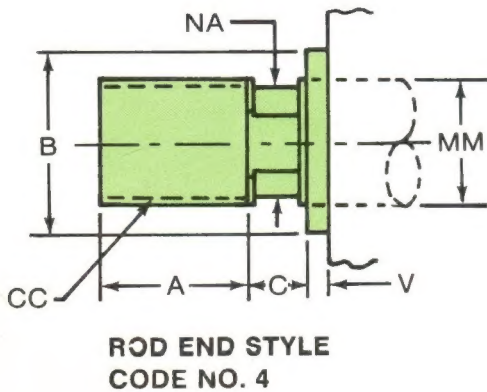
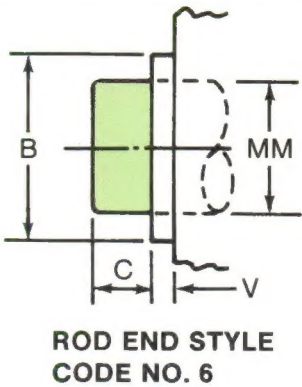
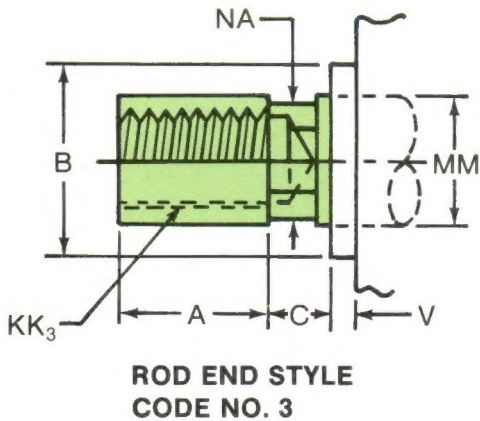
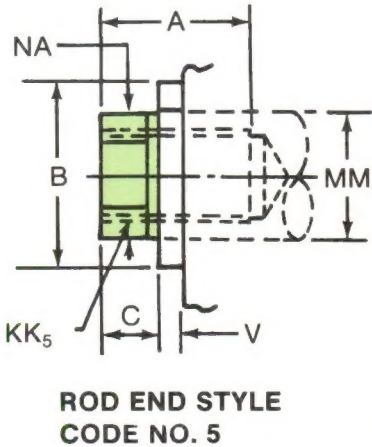
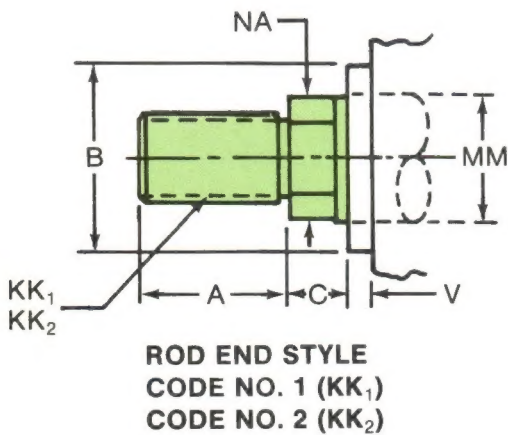
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	PERFORMANCE TESTED DESIGN FEATURES	5
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PISTON ROD
END STYLES

Piston rod end dimensional data

TABLE 3 Piston rod end styles

Caution —
When ordering replacement cylinders for competitive brands our Style No. 1 Rod Ends may not be interchangeable with other cylinder manufacturers Style No. 1. Our Style No. 2 should be used if this applies to your application.



ROD MM	A	B -001 -003	C	CC	*D	KK -1-	KK 2-3-5	NA
5/8	3/4	1 1/8	3/8	5/8-18	1/2	1/2-20	7/16-20	19/32
1	1 1/8	1 1/2	1/2	1-14	7/8	7/8-14	3/4-16	31/32
1 3/8	1 5/8	2	5/8	1 3/8-12	1 1/8	1 1/4-12	1-14	1 11/32
1 3/4	2	2 3/8	3/4	1 3/4-12	1 1/2	1 1/2-12	1 1/4-12	1 45/64
2	2 1/4	2 5/8	7/8	2-12	1 11/16	1 3/4-12	1 1/2-12	1 61/64
2 1/2	3	3 3/8	1	2 1/2-12	2 1/16	2 1/4-12	1 7/8-12	2 29/64
3	3 1/2	3 3/4	1	3-12	2 5/8	2 3/4-12	2 1/4-12	2 15/16
3 1/2	3 1/2	4 1/4	1	3 1/2-12	3	3 3/4-12	2 1/2-12	3 7/16
4	4	4 3/4	1	4-12	3 3/8	3 3/4-12	3-12	3 15/16
4 1/2	4 1/2	5 1/4	1	4 1/2-12	3 7/8	4 1/4-12	3 3/4-12	4 27/64
5	5	5 3/4	1	5-12	4 1/4	4 3/4-12	3 1/2-12	4 59/64
5 1/2	5 1/2	6 1/4	1	5 1/2-12	4 5/8	5 1/4-12	4-12	5 27/64
7	7	8	1	7-12	6	6 1/2-12	5 1/2-12	6 57/64

*Distance across wrench flats

When your requirements call for . . .

- proven performance
- expert workmanship
- advanced engineering
- quality materials



ask for Milwaukee . . .

We're proud of our role as a supplier of NFPA Industrial Cylinders to a good selection of some of the outstanding manufacturers in our country. When the cylinder they are buying must have built in performance qualifications they not only turn to us, but keep coming back for more. We've supplied cylinders for use in agriculture irrigation, for food processing equipment, machinery used in automotive and truck manufacturing.

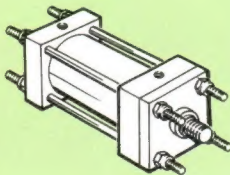
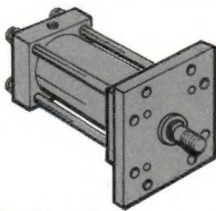
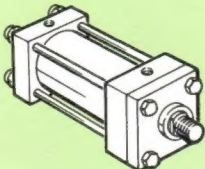
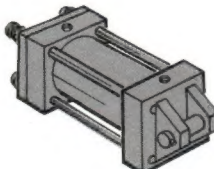
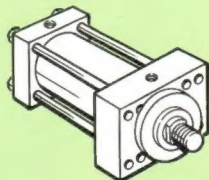
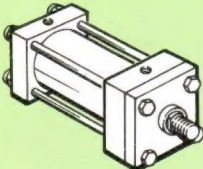
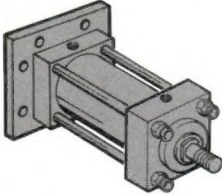
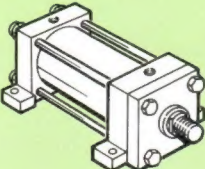
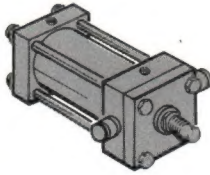
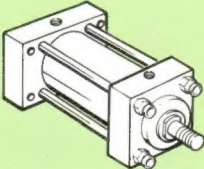
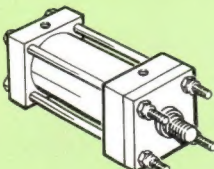
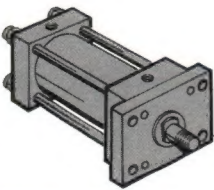
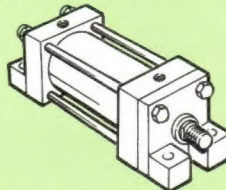
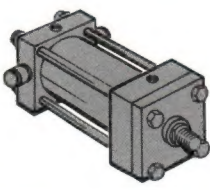
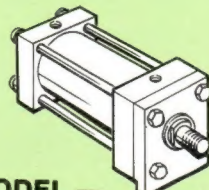
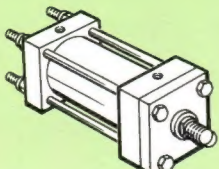
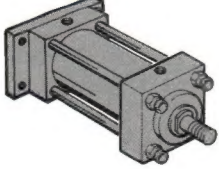
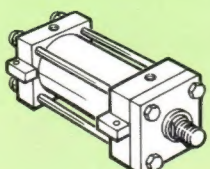
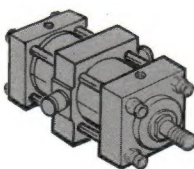
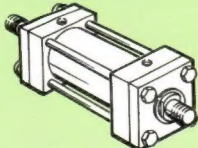
We also supply cylinders for the machine tool industry, testing equipment, and materials handling. At Milwaukee our standard line of cylinders offer an extensive variety for most jobs. If a standard won't fit your bill we're specialists in engineering entirely different cylinders to perform the functions you require. Remember if you take as much pride in your product as we take in ours, we'd like to work with you.

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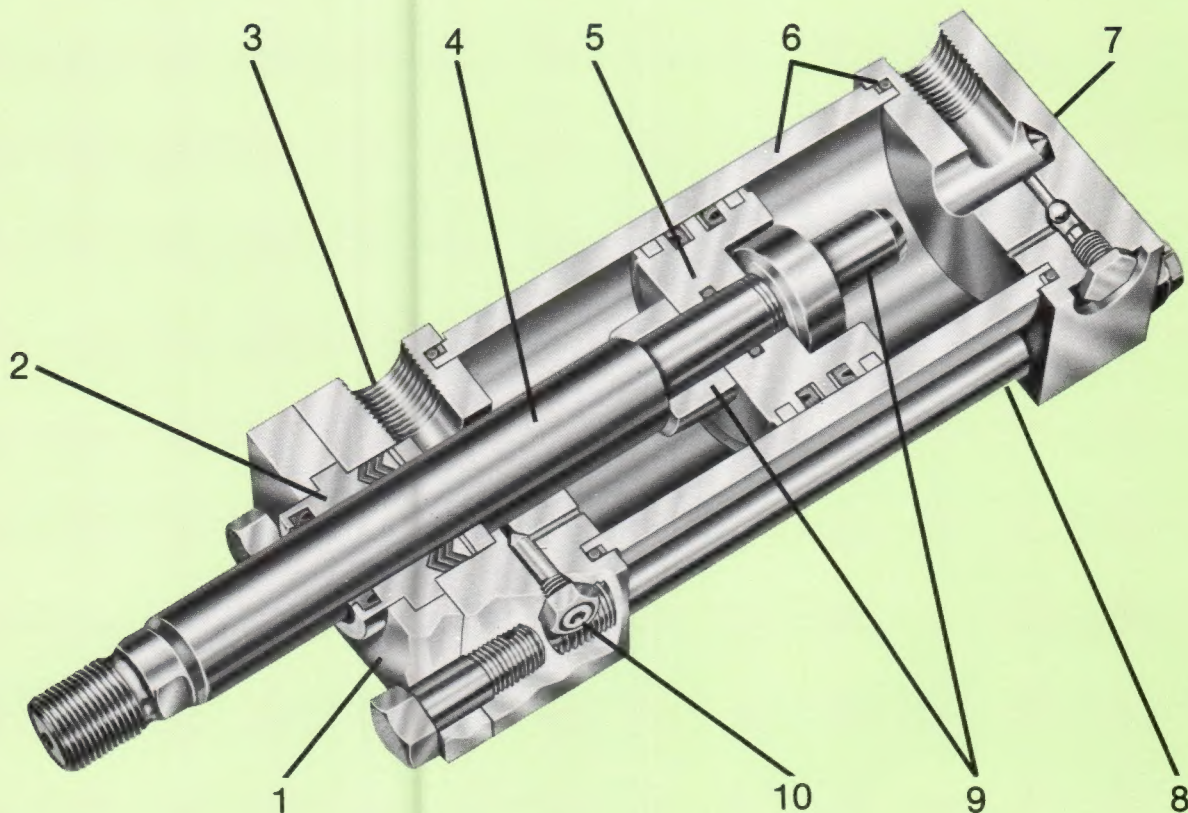
5877 South Pennsylvania Ave. • Cudahy, WI 53110
Phone (414) 769-9700 • TWX-910-262-1162

Quick index

MILWAUKEE Series "H" hydraulic cylinders are built to perform on the toughest applications. Incorporating a variety of MILWAUKEE "Exclusive" advanced features, proven through the years, these cylinders will provide a long maintenance free service life. Advanced engineering combined with quality materials and expert workmanship contribute to the making of a rugged top quality hydraulic cylinder.

				
MODEL H10 NFPA MX1 PAGE 6	MODEL H21 NFPA MF5 PAGE 8	MODEL H41 NFPA MS4 PAGE 10	MODEL H61 NFPA MP1 PAGE 12	MODEL H35 NFPA ME5 PAGE 14
				
MODEL H11 NFPA MX PAGE 6	MODEL H22 NFPA MF6 PAGE 8	MODEL H42 NFPA MS2 PAGE 10	MODEL H71 NFPA MT1 PAGE 12	MODEL H36 NFPA ME6 PAGE 14
				
MODEL H12 NFPA MX3 PAGE 6	MODEL H31 NFPA MF1 PAGE 8	MODEL H43 NFPA MS7 PAGE 10	MODEL H72 NFPA MT2 PAGE 12	MODEL — KEY MOUNT PAGE 14
				
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Standard specifications and features



Standard Specifications

- **STANDARD CONSTRUCTION—**
SQUARE HEAD-TIE ROD DESIGN
- **NOMINAL PRESSURE-3000 PSI**
***(5000 PSI NON-SHOCK)**
- **STANDARD FLUID-HYDRAULIC OIL**
- **STANDARD TEMPERATURE—**
—20 F TO +250 F
- **STANDARD BORE SIZES—**
1½" THRU 12"
- **STANDARD PISTON ROD DIAMETERS**
5/8" THRU 7"
- **STANDARD MOUNTING STYLES—**
18 STANDARD STYLES AND CUSTOM
DESIGNS TO SUIT YOUR NEEDS
- **STROKES-AVAILABLE IN ANY PRACTICE**
STROKE LENGTH
- **CUSHIONS-AVAILABLE AT EITHER**
END OR BOTH ENDS OF STROKE
- **STANDARD 6 ROD END STYLES**
AND SPECIALS DESIGNED TO ORDER

*If your hydraulic operating pressure exceeds 3000 PSI, send your application data for engineering evaluation and design recommendations.

Standard Features

1. Removable Retainer Plate

The retainer plate and rod bushing are externally removable without disassembling the cylinder on most standard models. Four self-locking capscrews securely hold and lock the retainer plate in place.

2. Rod Bearing and Seals

A combination of spring loaded multiple lip vee rings with a supporting bronze bushing is standard in Milwaukee Series "H" cylinders.

3. Ports

Large NPTF cylinder ports are provided and can be rotated to any 90 degree position in relation to each other and the mounting.

4. Piston Rod

The piston rod is of high strength steel, hardened and plated to resist scoring and corrosion assuring maximum life.

5. Piston

The piston is of fine grained alloy iron, incorporating a combination of block vee and cast iron rings insuring non-leak Hi-Lo pressure performance. The piston is pilot fitted and locked to the rod with a nut that is staked.

6. Cylinder Barrel and Seals

The barrel is of steel tubing honed to a fine finish to assure superior sealing, minimum friction and maximum seal life. It is step cut on the O.D. of both ends for an o-ring and molded back-up washer. "Milwaukee's" unique non-extrusion barrel seal design provides a positive leak tight seal.

7. End Caps

End caps and mountings are of high quality steel precision machined for accurate mounting.

8. Tie Rods and Nuts

The tie rods are constructed from a high quality medium carbon steel. The threads are accurately machined for rigid engagement of the self-locking nuts.

9. Cushions

The cushions are machined to close tolerance to provide positive, smooth deceleration at the end of stroke.

10. Cushion Needle Adjustment and Ball Check

The cushion needle adjustment valve and cushion-check ball retainer screw are specially designed to provide full cushion adjustment and sealed with a Teflon ring seal to prevent leakage.

Performance tested design features



Simple Maintenance . . .

Simple maintenance is a reality with a "Milwaukee" cylinder. The rod bushing or rod seals can be inspected or serviced by merely removing the Nylok Cap Screws and retainer plate on most models. Standard available shop tools can be used to remove the rod bushing and seals without disturbing the torque on the tie rods assuring performance quality with maintenance ease.

optional, one-piece bushing and rod seal

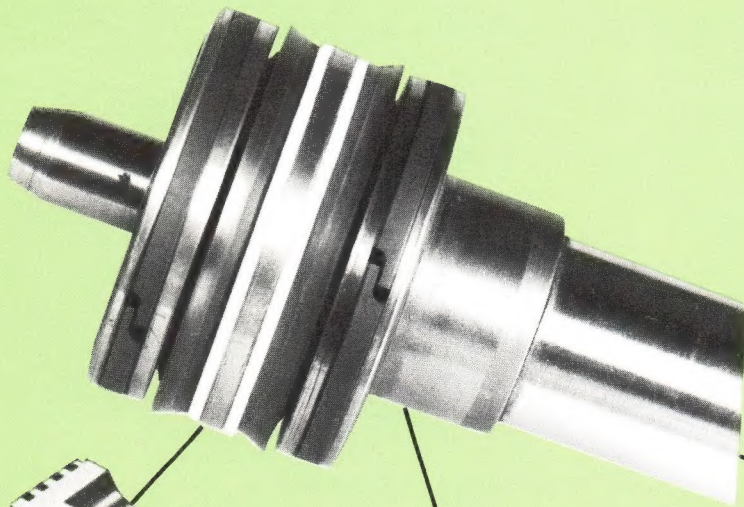


Combination Rod Seal Design . . .

The Milwaukee Series "H" cylinder combines spring loaded multiple lip vee rings with a supporting bronze bearing ring bushing and a double lip wiper as a secondary seal. This proven rod seal design combination is effective at both high and low pressures. It affords in addition to maximum sealing, an extra long bearing support.

As an optional design, a one-piece rod bushing with a single lip block vee seal and a double lip wiper is available. Metallic rod scrapers may be supplied on request, in place of the double lip wiper with either rod bushing design.

The unique versatility of the Milwaukee Series "H" design makes available a selection of seals to meet all types of service conditions.



Combination Sealing Piston . . .

The Milwaukee Series "H" cylinder combines two bi-directional sealing cast iron piston rings, with two block vee seals with Teflon back-ups and a fine grained alloy iron piston. This proven piston seal design is effective at both high and low pressures. The design gives the wear and shock absorbing qualities of cast iron and the near zero leakage of the block vee seal.

As an optional design, a piston using four low friction cast iron rings is available.



optional piston design . . . four cast iron rings

CUSHIONS . . .

The cushion is of a high grade alloy, precision machined and specially tapered to provide smooth deceleration of the piston at the end of stroke. A standard manufacturing process at Milwaukee is to assemble the piston, cushion, and the piston rod; placing the assembly between centers and grinding the critical diameters concentric. This is to assure that our customers receive the total quality of performance that is designed into a Milwaukee Cylinder.

PISTON ROD . . .

The piston rod is hardened, plated high strength steel, machined and processed to resist scoring and corrosion assuring maximum life. Milwaukee offers six rod end styles as standard. The style #1 rod end with two wrench flats is furnished as standard unless the customer specifies another style. Special rod ends and extra wrench flats are available at a slightly extra charge. They must be specified at the time of order giving the dimensional requirements and the location of additional wrench flats.

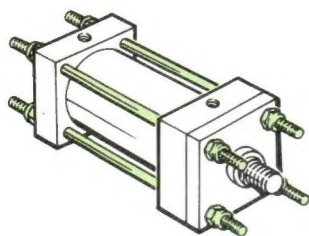
TIE-ROD MOUNT

The flange and tie-rod mounts are basically the same except that the cylinder tie rods are extended and used to mount the cylinder. To prevent misalignment, sagging, or possible binding of the cylinder, when long strokes are required, the free end should be supported. The best use of tie-rods when extended on the

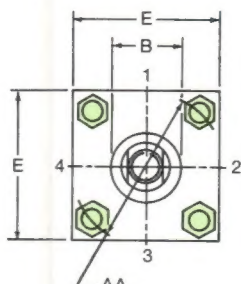
blind end is in a thrust load application. When using tie-rods extended on the rod end, the best application is a tension load. Tie rod mounts are suited for many applications, but it should be noted that they are not as rigid as the flange type of mounting.

FOR PACKAGE AND MOUNTING DIMENSIONS SEE TABLES 1 AND 2

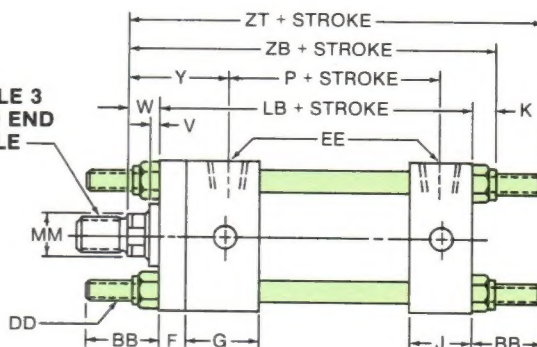
TIE-RODS EXTENDED BOTH ENDS



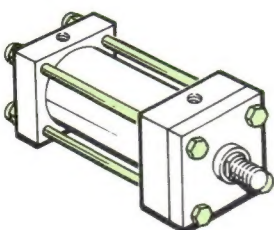
**MODEL H10
NFPA STYLE MX1**



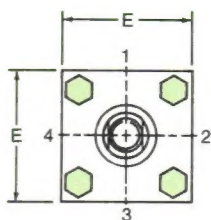
**TABLE 3
ROD END
STYLE**



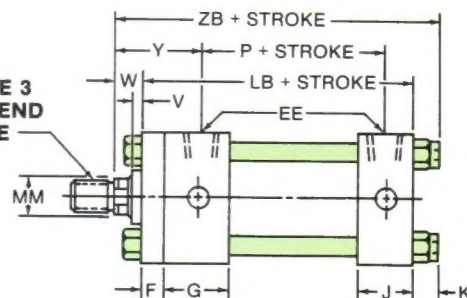
NO TIE-ROD EXTENSION



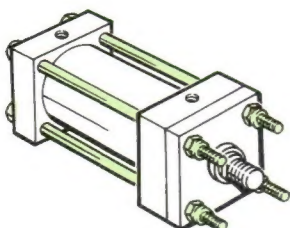
**MODEL H11
NFPA STYLE MX**



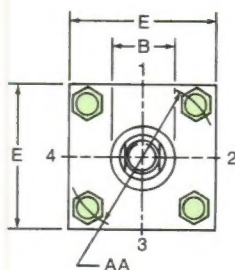
**TABLE 3
ROD END
STYLE**



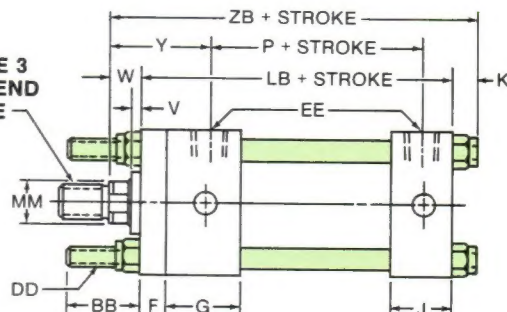
TIE-RODS EXTENDED ROD END



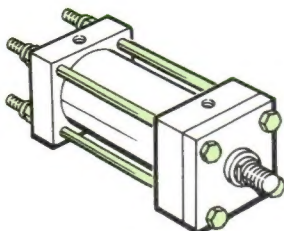
**MODEL H12
NFPA STYLE MX3**



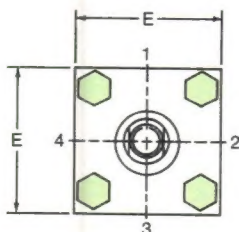
**TABLE 3
ROD END
STYLE**



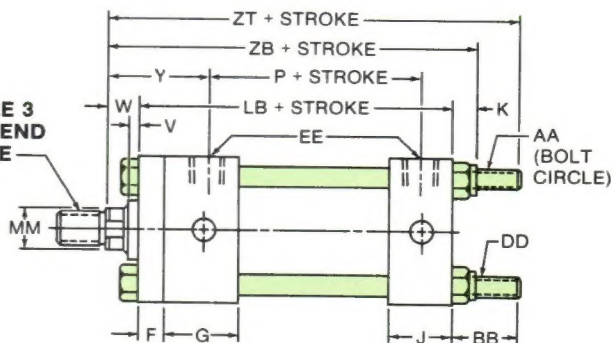
TIE-RODS EXTENDED BLIND END



**MODEL H13
NFPA STYLE MX2**



**TABLE 3
ROD END
STYLE**



Dimensional data

TIE-ROD MOUNT

TABLE 1 The dimensions given on this table are affected by the piston rod diameter and the stroke.

BORE DIA.	ROD MM	CYLINDER CODE #	B	LB	P	V	W	Y	ZB	ZT
1½	⅝	151	1⅝	5	2⅞	¼	⅝	2	6⅝	7
	•1	152	1½			½	1	2⅜	6½	7⅞
2	1	1510	1½	5¼	2⅞	¼	¾	2⅜	6⅝	7⅜
	•1⅝	1511	2			⅜	1	2⅜	6⅝	8⅜
2½	1	1520	1½	5⅝	3	¼	¾	2⅜	6¾	7⅜
	1⅝	1521	2			⅜	1	2⅜	7	8⅜
	•1¾	1522	2⅝			½	1¼	2⅜	7¼	8⅜
3¼	1⅝	1530	2	6¼	3⅜	¼	⅞	2⅜	7⅞	9⅜
	1¾	1531	2⅝			⅜	1⅝	2⅜	8⅝	9⅜
	2	1532	2⅝			⅜	1¼	3⅜	8¼	9⅜
4	1¾	1540	2⅝	6⅝	3⅞	¼	1	2⅜	8⅝	9⅜
	2	1541	2⅝			¼	1⅝	3⅜	8½	10⅜
	2½	1542	3⅝			⅜	1⅝	3⅜	8¼	10⅜
5	2	1550	2⅝	7⅝	4⅜	¼	1⅝	3⅜	9¼	11⅜
	2½	1551	3⅝			⅜	1⅝	3⅜	9½	11⅜
	3	1552	3¾			⅜	1⅝	3⅜	9½	11⅜
	3½	1553	4¼			⅜	1⅝	3⅜	9½	11⅜
6	2½	1560	3⅝	8⅝	5	¼	1¼	3⅜	10¾	13¼
	3	1561	3¾			¼	1¼			
	3½	1562	4¼			¼	1¼			
	4	1563	4¾			¼	1¼			
7	3	1570	3¾	9½	5½	¼	1¼	3¾	12	14⅝
	3½	1571	4¼			¼	1¼			
	4	1572	4¾			¼	1¼			
	4½	1573	5¼			¼	1¼			
	5	1574	5¾			¼	1¼			
8	3½	1580	4¼	10½	6¼	¼	1¼	3⅝	13¼	16¼
	4	1581	4¾			¼	1¼			
	4½	1582	5¼			¼	1¼			
	5	1583	5¾			¼	1¼			
	5½	1584	6¼			¼	1¼			
10	4½	15100	5¼	13⅜	8½	¼	1¼	4¾	16⅜	21⅜
	5	15101	5¾			½	1½	5	16⅜	21⅜
	5½	15102	6¼			½	1½	5	16⅜	21⅜
12	5½	15120	6¼	16⅝	9⅝	¼	1¼	5½	19⅝	24⅜
	7	15121	8			¼	1¼	5½	19⅝	24⅜

HOW TO ORDER

For ordering information refer to Page 22.

NOTES:

#For double rod end cylinders the cylinder code number is to be written with the letter D.

•Available with fixed-nonadjustable cushions on rod end and standard adjustable cushions on the blind end only.

CUSHIONS:

The longest cushion is provided that can be accommodated by the rod and blind end caps in any given bore size. Longer cushions are available; for further information consult the factory.

PORTS:

Series H cylinders are supplied with NPTF tapered pipe threads as standard. The largest size port is provided that can be accommodated by the rod and blind end caps in any given bore size. For further information on different types of ports or oversized ports refer to page 17.

TABLE 2 These dimensions are constant regardless of rod diameter or stroke.

BORE	AA	BB	DD	E	EE	F	G	J	K
1½	2.3	1⅝	⅜-24	2½	½	⅜	1¾	1½	½
2	2.9	1⅜	½-20	3	½	⅝	1¾	1½	⅝
2½	3.6	1⅜	½-20	3½	½	⅝	1¾	1½	⅝
3¼	4.6	2⅝	⅝-18	4½	¾	¾	2	1¾	¾
4	5.4	2⅝	⅝-18	5	¾	⅞	2	1¾	¾
5	7.0	3⅝	⅞-14	6½	¾	⅞	2	1¾	1
6	8.1	3⅝	1-14	7½	1	1	2¼	2¼	1⅝
7	9.3	4⅝	1⅝-12	8½	1¼	1	2¾	2¾	1¼
8	10.6	4½	1¼-12	9½	1½	1	3	3	1½
10	13.62	6	1¾-12	12⅝	2	1⅜	3⅜	3⅜	1⅝
12	16.25	7	2-12	14⅞	2½	1⅝	4⅞	4⅞	1⅝

SEE TABLE 3
PAGE 2 FOR
ROD END STYLES
AND DIMENSIONS

FLANGE MOUNT

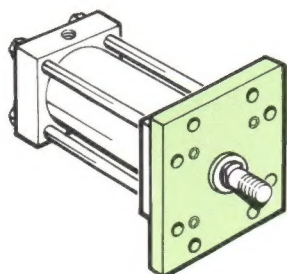
The flange mount is one of the strongest most rigid methods of mounting. With this type of mount there is little allowance for misalignment, though when long strokes are required the free end opposite the mounting should be supported to prevent sagging and possible binding of the cylinder. The best use of a blind end flange is in a thrust load application (rod in compression). Rod end flange mounts are best

used in tension applications. If an application exceeds the rectangular flange rating, requiring an extra heavy flange, a solid flange style end cap mount is available at no extra cost for most bore sizes (refer to pg. 14). When a less rigid mount can be used and the cylinder can be attached to a panel or bulkhead an extended tie rod mounting could be considered.

FOR PACKAGE AND MOUNTING DIMENSIONS SEE TABLES 1 AND 2

Recommended Pressure Rating —
Push Application

Bore	Std. Flange PSI Rating	3000 PSI-Required Flange Thickness
1½ — 4	3000	Standard
5	2200	1
6	1500	1½
7	1100	1¾
8	800	2
10	1300	2½
12	1000	3



**MODEL H21
NFPA STYLE MF5**

ROD SQUARE FLANGE MOUNTING

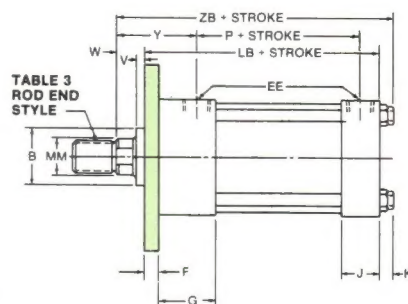
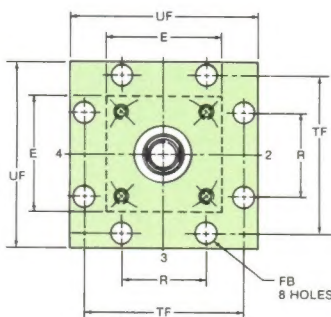
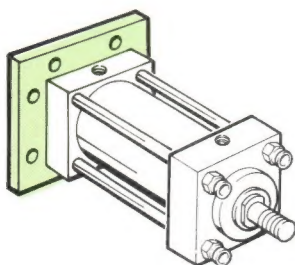


TABLE 3
ROD END
STYLE

Recommended Pressure Rating —
Pull Application

Bore	Std. Flange PSI Rating	3000 PSI-Required Flange Thickness
1½ — 4	3000	Standard
5	2200	1
6	1500	1½
7	1100	1¾
8	800	2
10	1300	2½
12	1000	3



**MODEL H22*
NFPA STYLE MF6**

BLIND SQUARE FLANGE MOUNTING

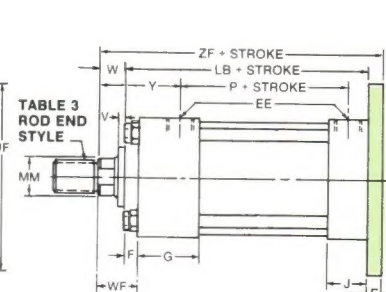
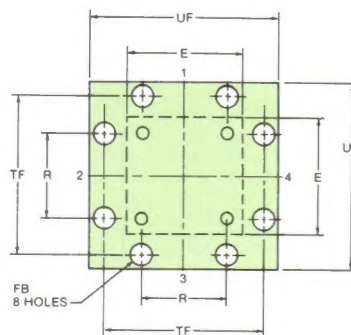
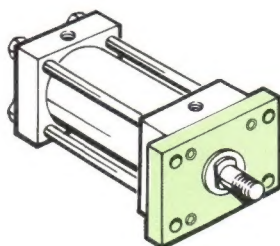


TABLE 3
ROD END
STYLE

Maximum Pressure Rating —
Push Application

Bore	Std. Flange PSI Rating	3000 PSI-Required Flange Thickness
1½ — 4	3000	Standard
5	2200	1
6	1500	1½
7	1100	1¾
8	800	2
10	1300	2½
12	1000	3



**MODEL H31
NFPA STYLE MF1**

ROD RECTANGULAR FLANGE MOUNTING

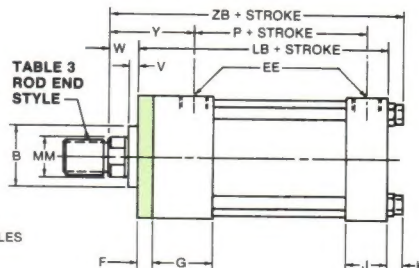
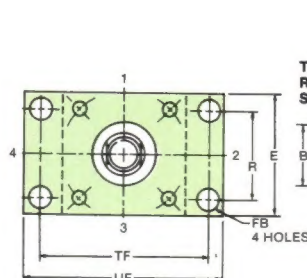
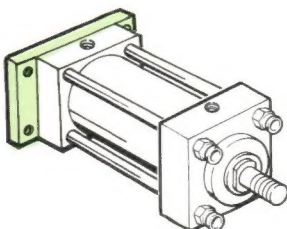


TABLE 3
ROD END
STYLE

Maximum Pressure Rating —
Pull Application

Bore	Std. Flange PSI Rating	3000 PSI-Required Flange Thickness
1½ — 4	3000	Standard
5	2200	1
6	1500	1½
7	1100	1¾
8	800	2
10	1300	2½
12	1000	3



**MODEL H32*
NFPA STYLE MF2**

BLIND RECTANGULAR FLANGE MOUNTING

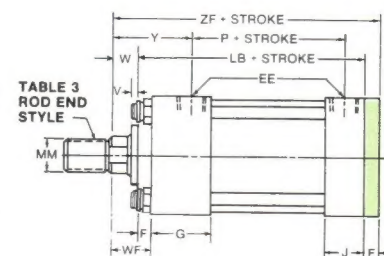
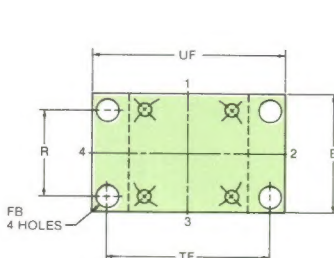


TABLE 3
ROD END
STYLE

Dimensional data

FLANGE MOUNT

TABLE 1 The dimensions given on this table are affected by the piston rod diameter and the stroke.

BORE DIA.	ROD MM	CYLINDER CODE #	B	LB	P	V	W	WF	Y	ZB	ZF
1½	⅝	151	1⅞	5	2⅞	¼	⅝		2	6⅞	6
	•1 ★	152	1½			½	1		2⅜	6½	6⅜
2	1	1510	1½	5¼	2⅞	¼	¾		2⅜	6⅞	6⅞
	•1⅜ ★	1511	2			⅜	1		2⅞	6⅞	6⅞
2½	1	1520	1½	5⅝	3	¼	¾		2⅜	6¾	6¾
	1⅜	1521	2			⅜	1		2⅞	7	7
	•1¾ ★	1522	2⅜			½	1¼		2⅞	7¼	7¼
3¼	1⅜	1530	2	6¼	3⅞	¼	⅞	1⅝	2⅜	7⅞	7⅞
	1¾	1531	2⅜			⅜	1⅞	1⅞	2⅜	8⅞	8⅞
	2	1532	2⅞			⅜	1¼	2	3⅜	8¼	8¼
4	1¾	1540	2⅜	6⅝	3⅞	¼	1	1⅞	2⅜	8⅞	8½
	2	1541	2⅞			¼	1⅞	2	3⅞	8½	8⅞
	2½	1542	3⅞			⅜	1⅞	2¼	3⅞	8¼	8⅞
5	2	1550	2⅞	7⅞	4⅜	¼	1⅞	2	3⅞	9¼	9⅞
	2½	1551	3⅞			⅜	1⅞	2¼	3⅞	9½	9⅞
	3	1552	3¼			⅜	1⅞	2¼	3⅞	9½	9⅞
	3½	1553	4¼			⅜	1⅞	2¼	3⅞	9½	9⅞
6	2½	1560	3⅞	8⅞	5	¼					
	3	1561	3¼			¼					
	3½	1562	4¼			¼	1¼	2¼	3⅞	10¾	10⅞
	4	1563	4¼			¼					
7	3	1570	3¼	9½	5½	¼					
	3½	1571	4¼			¼					
	4	1572	4¼			¼	1¼	2¼	3¾	12	11¾
	4½	1573	5¼			¼					
8	5	1574	5¼	10½	6¼	¼					
	3½	1580	4¼			¼					
	4	1581	4¾			¼	1¼	2¼	3⅞	13¼	12¾
	4½	1582	5¼			¼					
10	5	1583	5¼	13⅜	8½	¼					
	5½	1584	6¼			¼					
	4½	15100	5¼			¼	1¼		4¾	16⅜	16¾
12	5	15101	5¾	16⅞	9⅞	½	1½		5	16⅜	17
	5½	15102	6¼			½	1½		5	16⅜	17
	5½	15120	6¼			¼	1¼		5½	19⅞	19⅞
12	7	15121	8	16⅞	9⅞	¼	1¼		5½	19⅞	19⅞
						¼	1¼		5½	19⅞	19⅞

HOW TO ORDER

For ordering information refer to Page 22.

NOTES:

#For double rod end cylinders the cylinder code number is to be written with the letter D.

•Available with fixed-nonadjustable cushions on rod end and standard adjustable cushions on the blind end only.

* Removable retainer not available for these bore and rod combinations in the H22 and H32 mounting styles.

PORTS:

Series H cylinders are supplied with NPTF tapered pipe threads as standard. The largest size port is provided that can be accommodated by the rod and blind end caps in any given bore size. For further information on different types of ports or oversized ports refer to page 17.

CUSHIONS:

The longest cushion is provided that can be accommodated by the rod and blind end caps in any given bore size. Longer cushions are available; for further information consult the factory.

TABLE 2 These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	EE	F	FB	G	J	K	R	TF	UF
1½	2½	½	⅝	7⅞	1¾	1½	½	1.63	3⅞	4¼
2	3	½	⅝	9⅞	1¾	1½	⅝	2.05	4⅞	5⅞
2½	3½	½	⅝	9⅞	1¾	1½	⅝	2.55	4⅞	5⅞
3¼	4½	¾	¾	11⅞	2	1¾	¾	3.25	5⅞	7⅞
4	5	¾	¾	11⅞	2	1¾	¾	3.82	6⅞	7⅞
5	6½	¾	¾	15⅞	2	1¾	1	4.95	8⅞	9¾
6	7½	1	1	1⅞	2¼	2¼	1⅞	5.73	9⅞	11¼
7	8½	1¼	1	1⅞	2¼	2¼	1¼	6.58	10⅞	12⅞
8	9½	1½	1	1⅞	3	3	1½	7.50	11⅞	14
10	12⅞	2	1⅞	1⅞	3⅞	3⅞	1⅞	9.62	15⅞	19
12	14⅞	2½	1⅞	2⅞	4⅞	4⅞	1⅞	11.45	18½	22

SEE TABLE 3
PAGE 2 FOR
ROD END STYLES
AND DIMENSIONS

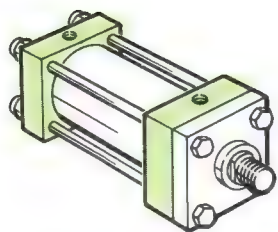
SIDE AND LUG MOUNTS

The side or lug mounted cylinder provides a fairly rigid mount. These types of cylinders can tolerate a slight amount of misalignment when the cylinder is at full stroke, but as the piston moves toward the blind end the tolerance for

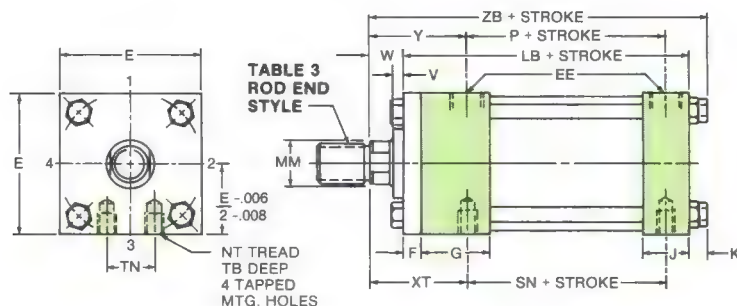
misalignment decreases. It is important to note that if the cylinder is used properly (without misalignment) the mounting bolts are either in simple shear or tension without any compound stresses.

FOR PACKAGE AND MOUNTING DIMENSIONS SEE TABLES 1 AND 2

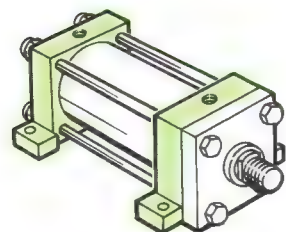
TAPPED HOLES IN CAPS FLUSH MOUNTING



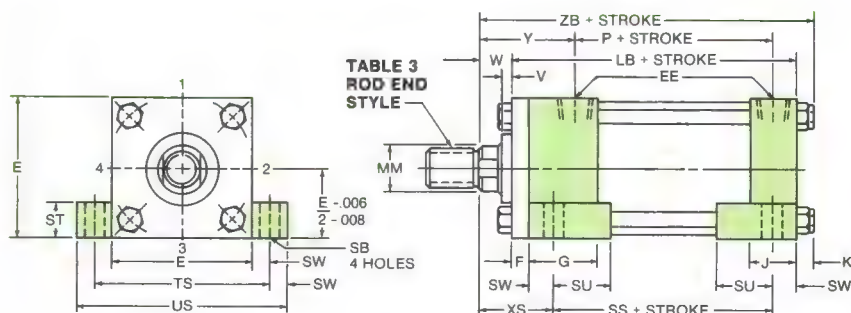
**MODEL H41
NFPA STYLE MS4**



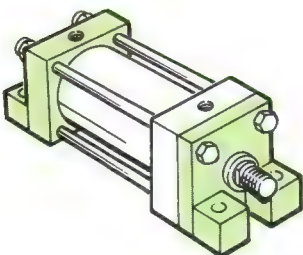
SIDE LUG MOUNTING



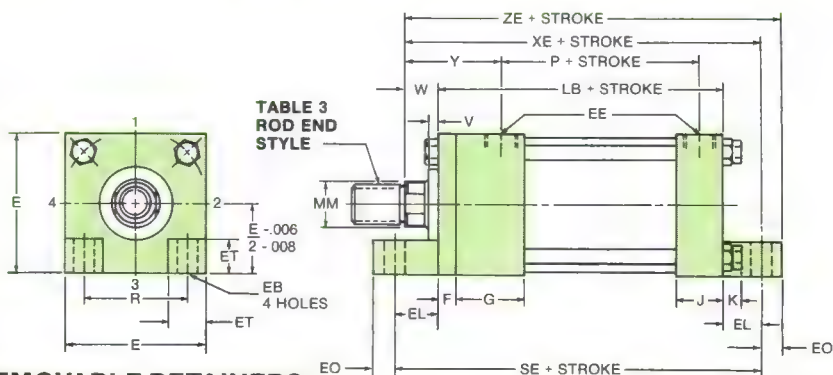
**MODEL H42
NFPA STYLE MS2**



FOOT MOUNTING

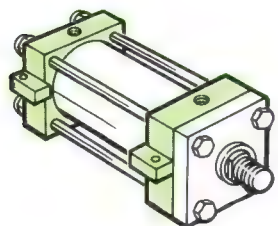


**MODEL H43
NFPA STYLE MS7**

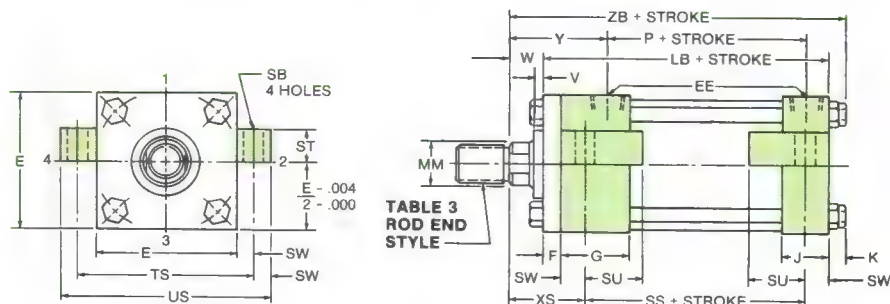


NOT AVAILABLE WITH REMOVABLE RETAINERS

CENTERLINE LUG MOUNTING



**MODEL H51
NFPA STYLE MS3**



Dimensional data

SIDE AND LUG MOUNTS

TABLE 1 The dimensions given on this table are affected by the piston rod diameter and the stroke.

BORE DIA.	ROD MM	CYLINDER CODE #	P	LB	SE [▲]	SN	SS [■]	V	W	XE	XT	XS	Y	ZB	ZE
1½	¾	151	2⅞	5	6¼	2⅞	3⅞	¼	¾	6½	2	1¾	2	6⅞	6⅞
	*•†1	152						½	1	6⅞	2⅞	1¾	2⅞	6⅞	7¼
2	1	1510	2⅞	5¼	7⅞	2⅞	3⅞	¼	¾	6⅞	2⅞	1¾	2⅞	6⅞	7⅞
	†•*1⅞	1511						¾	1	7⅞	2⅞	2⅞	2⅞	6⅞	7⅞
2½	1	1520	3	5⅞	7¼	3	3⅞	¼	¾	7⅞	2⅞	2⅞	2⅞	6¾	7⅞
	*1⅞	1521						¾	1	7⅞	2⅞	2⅞	2⅞	7	7⅞
	†•*1⅞	1522						½	1¼	7⅞	2⅞	2⅞	2⅞	7¼	8⅞
3¼	1¾	1530	3⅞	6¼	8½	3½	4⅞	¼	¾	8¼	2¾	2⅞	2⅞	7⅞	8⅞
	1¾	1531						¾	1⅞	8½	3	2⅞	2⅞	8⅞	9⅞
	*† 2	1532						¾	1¼	8⅞	3⅞	2⅞	3⅞	8¼	9¼
4	1¾	1540	3⅞	6⅞	8⅞	3¼	4	¼	1	8¾	3	2¾	2⅞	8⅞	9⅞
	*2	1541						¼	1⅞	8⅞	3⅞	2⅞	3⅞	8½	9½
	* 2⅞	1542						¾	1⅞	9⅞	3⅞	3⅞	3⅞	8¼	9¼
5	2	1550	4⅞	7⅞	10⅞	4¼	4½	¼	1⅞	9¼	3⅞	2⅞	3⅞	9¼	10½
	2⅞	1551						¾	1⅞	10	3⅞	3⅞	3⅞	9½	10¾
	3	1552						¾	1⅞	10	3⅞	3⅞	3⅞	9½	10¾
	* 3⅞	1553						¾	1⅞	10	3⅞	3⅞	3⅞	9½	10¾
6	2⅞	1560	5	8⅞	11¼	5⅞	5⅞	¼	1¼	11⅞	3½	3⅞	3⅞	10¾	12⅞
	3	1561						¼	1¼						
	3⅞	1562						¼	1¼						
	*4	1563						¼	1¼						
7	3	1570	5½	9½	13⅞	5⅞	5¼	¼	1¼	12⅞	3⅞	3⅞	3¼	12	13½
	3⅞	1571						¼	1¼						
	4	1572						¼	1¼						
	*4½	1573						¼	1¼						
8	* 5	1574	6¼	10½	14½	6⅞	6¼	¼	1¼	13¼	3⅞	3⅞	3⅞	13¼	14⅞
	3⅞	1580						¼	1¼						
	4	1581						¼	1¼						
	4½	1582						¼	1¼						
10	5	1583	8½	13⅞	---	8½	8⅞	¼	1¼	---	5	4⅞	4¼	16⅞	---
	* 5⅞	1584						¼	1¼						
	5	15100						½	1½						
12	5⅞	15101	9⅞	16⅞	---	10⅞	10½	½	1½	---	5¼	5⅞	5⅞	19⅞	---
	5⅞	15102						½	1½						
	7	15121						¼	1¼						

TABLE 2 These dimensions are constant regardless of rod diameter or stroke.

BORE	E	EB	EE	EL	EO	ET	F	G	J	K	NT	R	SB	ST	SU	SW	TB	TN	TS	US
1½	2½	7/16	½	7/8	¾	¾	¾	1¼	1½	½	¾-16	1.63	7/16	½	15/16	¾	9/16	¾	3¼	4
2	3	9/16	½	15/16	¾	¾	¾	1¼	1½	¾	½-13	2.05	9/16	¾	1¼	½	5/8	15/16	4	5
2½	3½	9/16	½	15/16	¾	¾	¾	1¼	1½	¾	¾-11	2.55	13/16	1	19/16	11/16	7/8	15/16	4½	6¼
3¼	4½	11/16	¾	1⅞	¾	1⅞	¾	2	1¾	¾	¾-10	3.25	13/16	1	19/16	11/16	1	1½	5⅞	7¼
4	5	11/16	¾	1⅞	¾	1⅞	¾	2	1¾	¾	1-8	3.82	1⅞	1¼	2	7/8	1⅞	2⅞	6¼	8½
5	6½	15/16	¾	1½	¾	1½	¾	2	1¾	1	1-8	4.95	1⅞	1¼	2	7/8	1½	2⅞	8¼	10
6	7½	1⅞	1	1⅞	13/16	1⅞	1	2¼	2¼	1⅞	1¼-7	5.73	1⅞	1½	2½	1⅞	1¾	3⅞	9¼	12
7	8½	1⅞	1¼	1⅞	15/16	1¼	1	2¾	2¾	1¼	1½-6	6.58	1⅞	1¾	2⅞	1⅞	1⅞	3¾	11¼	14
8	9½	1⅞	1½	2	1⅞	2	1	3	3	1½	1½-6	7.50	1⅞	1¾	2⅞	1⅞	1⅞	4¼	12¼	15
10	12⅞	---	2	---	---	---	1⅞	3⅞	3⅞	1⅞	1½-6	9.62	1⅞	2¼	3½	1⅞	2¼	5¼	15⅞	19⅞
12	14⅞	---	2½	---	---	---	1⅞	4⅞	4⅞	1⅞	1½-6	11.45	1⅞	3	4¼	2	2¼	7¼	18⅞	22⅞

HOW TO ORDER

For ordering information refer to Page 22.

NOTES:

★ Model H41 is not available in these sizes.

† The standard rod eye or rod clevis will interfere with foot lugs on Model H43. When these rod end accessories are required use additional rod extension.

▲ For double rod end cylinders from 1½" thru 5" bore add ¼" + F to this dimension.

■ For double rod end cylinders from 1½" thru 5" bore add ¼" to this dimension.

• Available with fixed non-adjustable cushions on rod end and standard adjustable cushions on the blind end only.

For double rod end cylinders the cylinder code number is to be written with the letter D before it.

PORTS:

Series H cylinders are supplied with NPTF tapered pipe threads as standard. The largest size port is provided that can be accommodated by the rod and blind end caps in any given bore size. For further information on different types of ports or oversized ports refer to page 17.

CUSHIONS:

The longest cushion is provided that can be accommodated by the rod and blind end caps in any given bore size. Longer cushions are available; for further information consult the factory.

**SEE TABLE 3
PAGE 2 FOR
ROD END STYLES
AND DIMENSIONS**

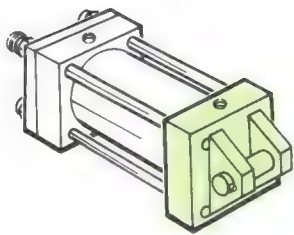
PIN AND TRUNNION MOUNTS

All pin and trunnion cylinders need a provision on both ends for pivoting. These types of cylinders are designed to carry shear loads and

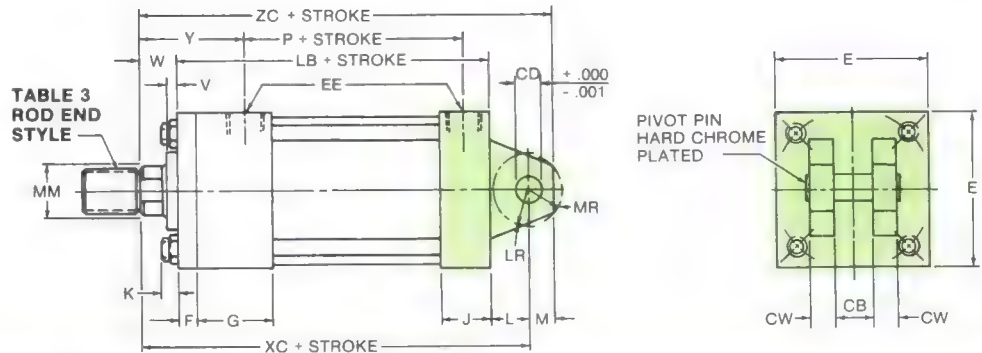
the trunnion and pivot pins should be carried by bearings that are rigidly held and closely fit for the entire length of the pin.

FOR PACKAGE AND MOUNTING DIMENSIONS SEE TABLES 1 AND 2

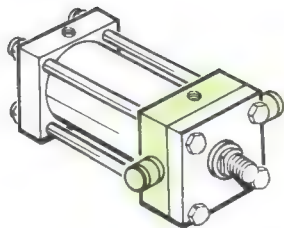
CLEVIS MOUNT



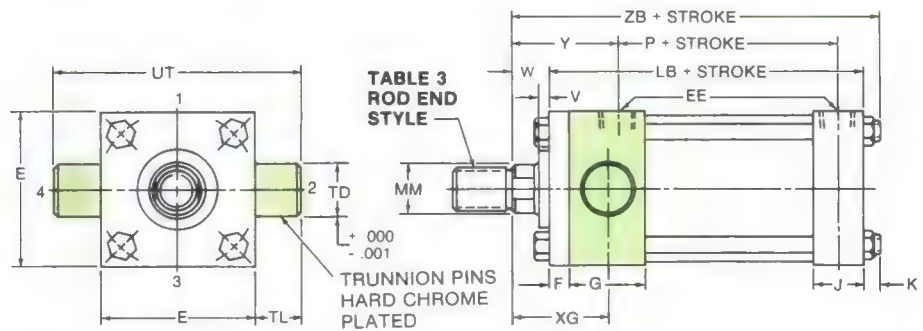
**MODEL H61
NFPA STYLE MP1**



ROD END TRUNNION MOUNT

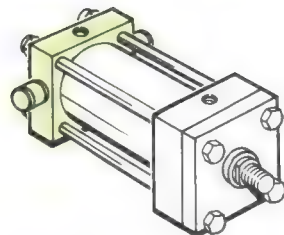


**MODEL H71
NFPA STYLE MT1**

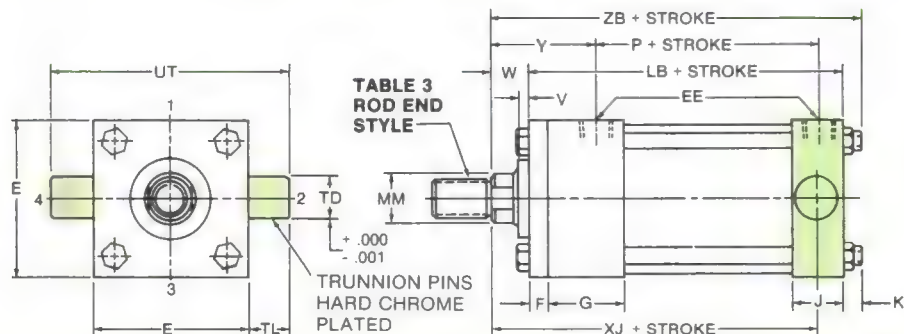


SEE CAUTION NOTE

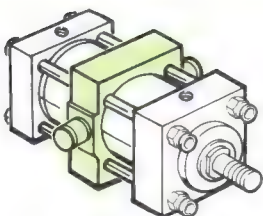
BLIND END TRUNNION MOUNT



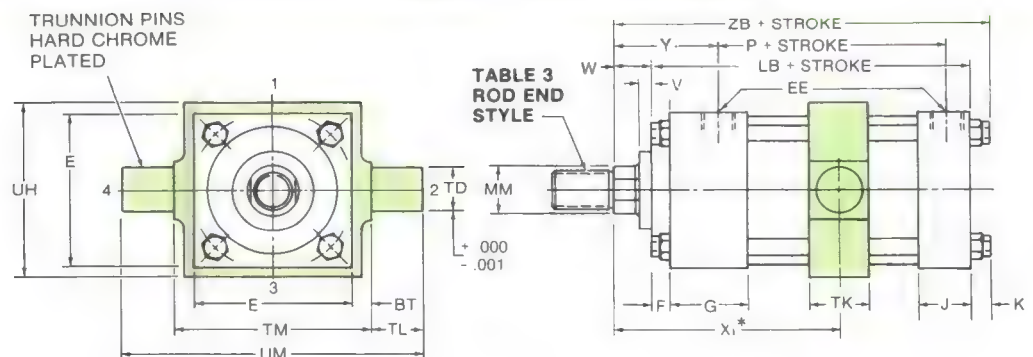
**MODEL H72
NFPA STYLE MT2**



CENTER TRUNNION MOUNT



**MODEL H73
NFPA STYLE MT4**



*Note: Customer to specify X_1 dimension

Dimensional data

PIN AND TRUNNION MOUNTS

TABLE 1 The dimensions given on this table are affected by the piston rod diameter and the stroke.

BORE DIA.	ROD MM	CYLINDER CODE #	P	LB	V	W	XC	XG	XJ	Y	ZB	ZC
1½	5/8	151	2½	5	¼	5/8	6¾	17/8	4¾	2	6¾	6¾
	•1 *	152			½	1	6¾	2¼	5¼	2¾	6½	7¼
2	1	1510	2½	5¼	¼	¾	7¼	2¼	5¼	2¾	6¾	8
	•1¾ *	1511			¾	1	7½	2½	5½	2¾	6¾	8¼
2½	1	1520	3	5¾	¼	¾	7¾	2¼	5¾	2¾	6¾	8¾
	1¾	1521			¾	1	7¾	2½	5¾	2¾	7	8¾
	•1¾ *	1522			½	1¼	7¾	2¾	5¾	2¾	7¼	8¾
3¼	1¾	1530	3 ¹⁹ / ₃₂	6¼	¼	7/8	8¾	2½	6¼	2 ²³ / ₃₂	7¾	9¾
	1¾	1531			¾	1	8¾	2¾	6½	2 ³¹ / ₃₂	8¾	9¾
	2	1532			¾	1¼	9	3	6½	3 ³ / ₃₂	8¼	10
4	1¾	1540	3¾	6¾	¼	1	9¾	2¾	6¼	2 ¹⁵ / ₁₆	8¾	11¾
	2	1541			¼	1½	9¾	3	6¾	3 ¹ / ₁₆	8½	11¼
	2½	1542			¾	1¾	10¾	3¼	7¾	3 ⁵ / ₁₆	8¾	11½
5	2	1550	4¾	7¾	¼	1½	10½	3	7¾	3 ¹ / ₁₆	9¼	12¾
	2½	1551			¾	1¾	10¾	3¼	7¾	3 ⁵ / ₁₆	9½	12¾
	3	1552			¾	1¾	10¾	3¼	7¾	3 ⁵ / ₁₆	9½	12¾
	3½	1553			¾	1¾	10¾	3¼	7¾	3 ⁵ / ₁₆	9½	12¾
6	2½	1560	5	8¾	¼	1¼	12¾	3¾	8¾	3 ¹ / ₁₆	10¾	14¾
	3	1561										
	3½	1562										
	4	1563										
7	3	1570	5½	9¾	¼	1¼	13¾	3¾	9¾	3¾	12	16¾
	3½	1571										
	4	1572										
	4½	1573										
8	5	1574										
	3½	1580	6¼	10¾	¼	1¼	15	3¾	10¼	3¾	13¼	17¾
	4	1581										
	4½	1582										
	5	1583										
10	5½	1584										
	4½	15100	8½	13 ¹³ / ₁₆	¼	1¼	19 ¹ / ₁₆	4¾	13¼	4¾	16 ¹¹ / ₁₆	22 ⁹ / ₁₆
	5	15101			½	1½	19 ¹ / ₁₆	5	13½	5	16 ¹⁵ / ₁₆	22 ¹³ / ₁₆
12	5½	15102			½	1½	19 ¹ / ₁₆	5	13½	5	16 ¹⁵ / ₁₆	22 ¹³ / ₁₆
	5½	15120	9¾	16 ⁷ / ₁₆	¼	1¼	22 ³ / ₁₆	5¾	15½	5½	19 ⁹ / ₁₆	26 ³ / ₁₆
	7	15121			¼	1¼	22 ³ / ₁₆	5¾	15½	5½	19 ⁹ / ₁₆	26 ³ / ₁₆

TABLE 2 These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	BT	CB	CD	CW	E	EE	F	G	J	K	L	LR	M	MR	TD	TK	TL	TM	UH	UM	UT
1½	¾	¾	½	½	2½	½	¾	1¼	1½	½	¾	¾	½	2 ¹ / ₃₂	1	1½	1	4	2½	6	4½
2	1	1¼	¾	¾	3	½	¾	1¼	1½	¾	1¼	1¼	¾	1 ¹⁵ / ₁₆	1¾	2	1¾	5	3¾	7¾	5¾
2½	1	1¼	¾	¾	3½	½	¾	1¼	1½	¾	1¼	1¼	¾	1 ¹⁵ / ₁₆	1¾	2	1¾	5½	4¾	8¼	6¼
3¼	1¼	1½	1	¾	4½	¾	¾	2	1¾	¾	1½	1¼	1	1 ¹³ / ₁₆	1¾	2½	1¾	7	5	10½	8
4	1¼	2	1¾	1	5	¾	¾	2	1¾	¾	2½	1¾	1¾	1¾	1¾	2½	1¾	7½	6½	11	8½
5	1¼	2½	1¾	1¼	6½	¾	¾	2	1¾	1	2¼	2	1¾	1¾	1¾	3	1¾	9	7½	12½	10
6	1½	2½	2	1¼	7½	1	1	2¼	2¼	1¾	2½	2½	2	2	2	3½	2	10½	8¾	14½	11½
7	1¾	3	2½	1½	8½	1¼	1	2¾	2¾	1¼	3	2¾	2¾	2¾	2½	4	2½	12	10	17	13½
8	1¾	3	3	1½	9½	1½	1	3	3	1½	3¼	2¾	2¾	2¾	3	4½	3	13	11	19	15½
10	2¼	4	3½	2	12¾	2	1 ¹¹ / ₁₆	3 ¹¹ / ₁₆	3 ¹¹ / ₁₆	1¾	4	3½	3½	3½	3½	5	3½	17¾	15¼	24¾	19¾
12	3	4½	4	2¼	14¾	2½	1 ¹⁵ / ₁₆	4¾	4¾	1¾	4½	4	4	4	4	5½	4	20¾	19¼	28¾	22¾

HOW TO ORDER

For ordering information refer to Page 22.

*CAUTION NOTE:

Rod end trunnion mount cylinders in bore sizes 5" through 8" with oversize piston rods and bore sizes 10" through 14" with all piston rod diameters should not be used over 1500 PSI. If your application requires higher pressure consult the factory.

NOTES:

#For double rod end cylinders the cylinder code number is to be written with the letter D.

•Available with fixed-nonadjustable cushions on rod end and standard adjustable cushions on the blind end only.

*Removable retainer not available for these bore and rod combinations: H-61 and H-73 mounting styles.

PORTS:

•Series H cylinders are supplied with NPTF tapered pipe threads as standard. The largest size port is provided that can be accommodated by the rod and blind end caps in any given bore size. For further information on different types of ports or oversized ports refer to page 17.

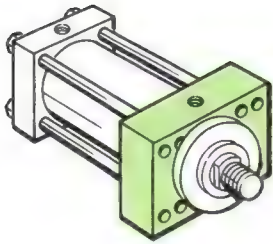
CUSHIONS:

The longest cushion is provided that can be accommodated by the rod and blind end caps in any given bore size. Longer cushions are available; for further information consult the factory.

**SEE TABLE 3
PAGE 2 FOR
ROD END STYLES
AND DIMENSIONS**

BLIND END SOLID FLANGE MOUNT ROD END SOLID FLANGE MOUNT KEY MOUNT • DOUBLE ROD END

FOR PACKAGE AND MOUNTING DIMENSIONS SEE TABLES 1 AND 2

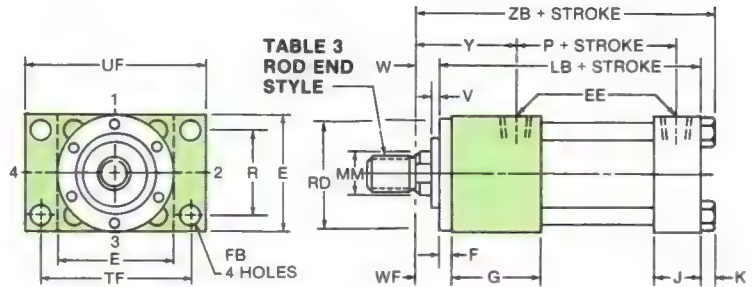


**MODEL H35
NFPA STYLE ME5**

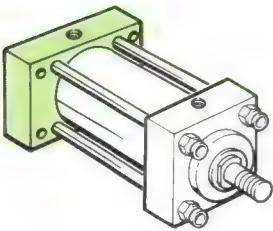
SOLID ROD END CAP FLANGE MOUNT

The solid rod end cap flange mount is one of the strongest most rigid method of mounting. This type of mounting is best in a tension application.

NOTE:
only available in 3 1/4"-8"
bore as standard



Flange rated for 3,000 PSI operation.

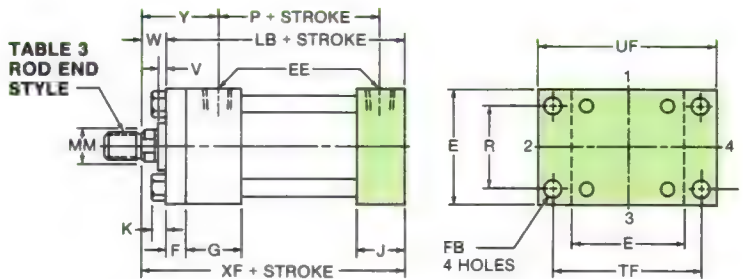


**MODEL H36
NFPA STYLE ME6**

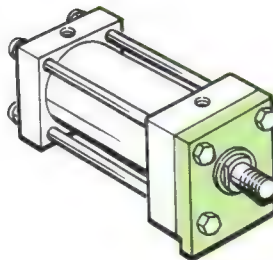
SOLID BLIND END CAP FLANGE MOUNT

The flange mount is one of the strongest most rigid methods of mounting. This type of mounting is best in a thrust load application.

NOTE:
only available in 3 1/4"-8"
bore as standard

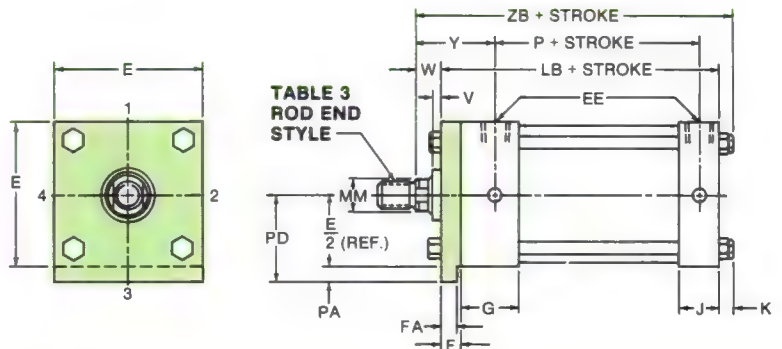


Flange rated for 3,000 PSI operation.



KEY MOUNT

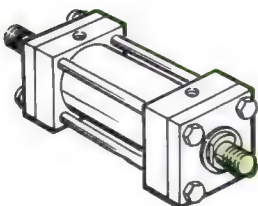
The Milwaukee Key Mount retainer plate is a mounting option designed to add rugged stability to foot and side mount cylinders. The retainer plate is extended below the mounting surface of the cylinder. This extension may be fitted into a milled keyway in your mounting pad, eliminating the need for welded keys or locator pins.



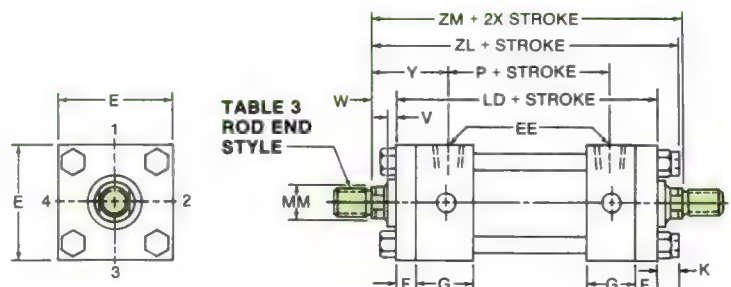
DOUBLE ROD END

Note:
For dimensions on specific mounting styles, consult the preceding pages. Dimensions shown on the adjacent drawing are for the basic cylinder only.

Double rod end styles are available in every mounting style except clevis. On double rod end cylinders where the rod ends are not the same be sure to specify clearly which rod end is to go at which end of the cylinder in relation to your mounting requirements.



NFPA STYLE MDX



Dimensional data

TABLE 1 The dimensions given on this table are affected by the piston rod diameter and the stroke.

BORE DIA.	ROD MM	CYLINDER CODE #	P	LB	LD	RD	V	W	WF	XF	Y	ZB	ZL	ZM
1½	5/8	151	2⅝	5	5⅝		¼	5/8			2	6⅝	6¾	6⅝
	•1	152					½	1			2⅝	6⅝	7⅝	7⅝
2	1	1510	2⅝	5¼	6⅝		¼	¾			2⅝	6⅝	7½	7⅝
	•1⅝	1511					¾	1			2⅝	6⅝	7¼	8⅝
2½	1	1520	3	5⅝	6¼		¼	¾			2⅝	6⅝	7⅝	7¼
	1⅝	1521					¾	1			2⅝	7	7⅝	8¼
	•1¾	1522					½	1¼			2⅝	7¼	8⅝	8¼
3¼	1⅝	1530	3⅝	6¼	7¼	3.50	¼	1	1⅝	7⅝	2⅝ ₃₂	7⅝	8⅝	9
	1¾	1531				3.50	¾	1⅝	1⅝	7⅝	2⅝ ₃₂	8⅝	9⅝	9½
	2	1532				4.00	¾	1¼	2	7⅝	3⅝ ₃₂	8¼	9¼	9¼
4	1¾	1540	3⅝	6⅝	7¼	3.50	¼	1	1⅝	7⅝	2⅝ ₁₆	8⅝	9½	9¼
	2	1541				4.00	¼	1⅝	2	7¼	3⅝ ₁₆	8½	9⅝	10
	2½	1542				4.50	¾	1⅝	2¼	8	3⅝ ₁₆	8¼	9⅝	10½
5	2	1550	4⅝	7⅝	8¼	4.00	¼	1⅝	2	8¼	3⅝ ₁₆	9¼	10⅝	10½
	2½	1551				4.50	¾	1⅝	2¼	8½	3⅝ ₁₆	9½	10⅝	11
	3	1552				5.12	¾	1⅝	2¼	8½	3⅝ ₁₆	9½	10⅝	11
	3½	1553				5.50	¾	1⅝	2¼	8½	3⅝ ₁₆	9½	10⅝	11
6	2½	1560	5	8⅝	9⅝	4.50					9⅝			
	3	1561				5.50					9⅝			
	3½	1562				5.88	¼	1¼	2¼		9⅝	3⅝ ₁₆	10¼	11¼
	4	1563				6.38					9⅝			
7	3	1570	5½	9½	10½	5.50					10¼			
	3½	1571				5.88					10¼			
	4	1572				6.38	¼	1¼	2¼		10¼	3¼	12	13
	4½	1573				6.88					10¼			
	5	1574				7.31					10¼			
8	3½	1580	6¼	10½	11½	5.88					11¼			
	4	1581				6.38					11¼			
	4½	1582				6.88	¼	1¼	2¼		11¼	3⅝	13¼	14¼
	5	1583				7.31					11¼			
	5½	1584				8.43					11¼			
10	4½	15100	8½	13⅝ ₁₆	15½		¼	1¼		---	4¾	16⅝ ₁₆	18⅝	18
	5	15101					½	1½		---	5	16⅝ ₁₆	19⅝	18½
	5½	15102					½	1½		---	5	16⅝ ₁₆	18⅝	18½
12	5½	15120	9⅝	16⅝ ₁₆	18⅝		¼	1¼		---	5½	19⅝ ₁₆	21¼	20⅝
	7	15121					¼	1¼		---	5½	19⅝ ₁₆	21¼	20⅝

HOW TO ORDER

For ordering information refer to Page 22.

NOTES:

#For double rod end cylinders the cylinder code number is to be written with the letter D.

•Available with fixed-nonadjustable cushions on rod end and standard adjustable cushions on the blind end only.

PORTS:

Series H cylinders are supplied with NPTF tapered pipe threads as standard. The largest size port is provided that can be accommodated by the rod and blind end caps in any given bore size. For further information on different types of ports or oversized ports refer to page 17.

CUSHIONS:

The longest cushion is provided that can be accommodated by the rod and blind end caps in any given bore size. Longer cushions are available; for further information consult the factory.

TABLE 2 These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	EE	F	FA	FB	G	J	K	PA	PD	R	TF	UF
1½	2½	½	¾	.312/ .310	7/16	1¾	1½	½	¾	1⅝			
2	3	½	¾	.562/ .560	9/16	1¾	1½	¾	¾	1⅝			
2½	3½	½	¾	.562/ .560	9/16	1¾	1½	¾	¾	2⅝			
3¼	4½	¾	¾	.687/ .684	1⅞	2	1¾	¾	¾	2⅝	3.25	5⅝	7⅝
4	5	¾	¾	.812/ .809	1⅞	2	1¾	¾	¾	2⅝	3.82	6⅝	7⅝
5	6½	¾	¾	.812/ .809	1⅞	2	1¾	1	¾	3⅞	4.95	8⅝	9¼
6	7½	1	1	.937/ .934	1⅞	2¼	2¼	1⅝	½	4¼	5.73	9⅝	11¼
7	8½	1¼	1	.937/ .934	1⅞	2¼	2¼	1¼	½	4¼	6.58	10⅝	12⅝
8	9½	1½	1	.937/ .934	1⅞	3	3	1½	½	5¼	7.50	11⅝	14
10	12⅝	2	1⅞	1.625/1.620	1⅞	3⅞	3⅞	1⅝	¾	7⅝	---	---	---
12	14⅝	2½	1⅞	1.875/1.870	2⅞	4⅞	4⅞	1⅞	¾	8⅝	---	---	---

SEE TABLE 3
 PAGE 2 FOR
 ROD END STYLES
 AND DIMENSIONS

Modifications

Design options

Special Cylinders

MILWAUKEE CYLINDER has two basic identities as a cylinder producer. The first, as a supplier of standard Hydraulic and Air Cylinders. The second as a specialist in the design and manufacture of totally unique cylinders to suit the wide range of applications for cylinders being developed into today's industry. Milwaukee is a customer and engineering orientated company which gladly welcomes a challenge to meet every customer's unique needs in the area of specials. For information on what data is required by Milwaukee to develop a design to suit your needs contact either your local Milwaukee representative or the factory.

Special Rod Ends

Modifications of standard or entirely special rod ends are available from Milwaukee at a slightly additional charge. When your requirements call for a special rod end style your order should include a sketch if it is to be an entirely special rod end or note reference as to which letter dimensions you wish to have modified (ref. pg. 2, 6-13 and 23).

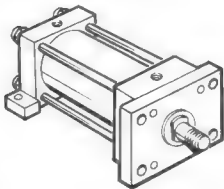
Special Assemblies From Standard Parts

This catalog was designed to aid in communication and simplify the placing of orders by our customers. On pages 2, 6-13 and 23 each style, of the various standard cylinder mountings, is illustrated using the commonly recognized cylinder dimensional symbols of the National Fluid Power Association. Each side of the end views are numbered to aid in communication when referring to the relationship between the ports and the mountings. When requesting information or placing an order, that requires a dimension other than standard, always make reference to the given dimensional symbol in the catalog and then give your requirements.

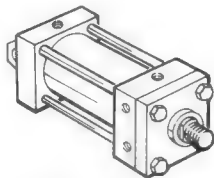
Combined Mountings

Standard mountings may be combined when specified by the customer. Some examples of this are:

1. An H31 mount constructed with an H42 mount blind end cap.



2. An H61 mount constructed with an H41 mount rod end cap.



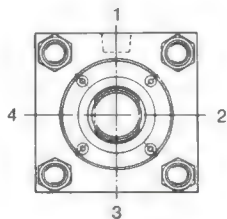
These and other combinations can be readily made from standard parts. If you are unsure of a possible combination or if it will suit your particular needs consult with your local Milwaukee representative or contact the factory.

Cushion Adjustment Locations

A ball check is supplied as standard in position #4 and a cushion adjustment needle is supplied as standard in position #2 on most models. The cushion needle and ball check are interchangeable as far as location and may be put in any side not occupied by a port or mounting.

Port Locations

Ports are located in position #1 as standard unless otherwise specified by the customer. By using the position numbers given with the end views in the dimensional data section (pg. 6-pg. 15) of this catalog, ports can be arranged in anyone of four 90 degree positions in relation to the cylinder mounting without charge. When ports are relocated on a cushioned cylinder the cushion needle and ball check are automatically relocated to hold their relationship to the port as on a standard cylinder unless otherwise specified at the time of the order.



Removable Trunnion Pins

If specified by the customer removable trunnion pins are available on models H71 & H72 at a slightly additional cost. It is possible to have this type of trunnion pin on all bore and rod combinations, except on the largest oversize rod offered with each bore size on all model H71 cylinders.

Single Acting Cylinders

The Milwaukee Series "H" cylinders are designed for either single or double action. When used as a single acting cylinder, hydraulic power drives the piston in one direction only relying on either the load or an external force to return the piston after the pressure is exhausted.

Single Acting-spring Cylinders

Single acting spring return cylinders normally have a spring inside of the cylinder to return the piston to its original position. The application load and friction conditions must be specified when placing an order to properly size the spring. Also specify whether the spring is to return or advance the piston. A spring return cylinder is designed with a stop tube to act as a spring guide which prevents binding of the cylinder, due to mis-alignment of the spring. To accurately determine the cylinder length and mounting dimensions for your application contact your local Milwaukee Representative or the factory.

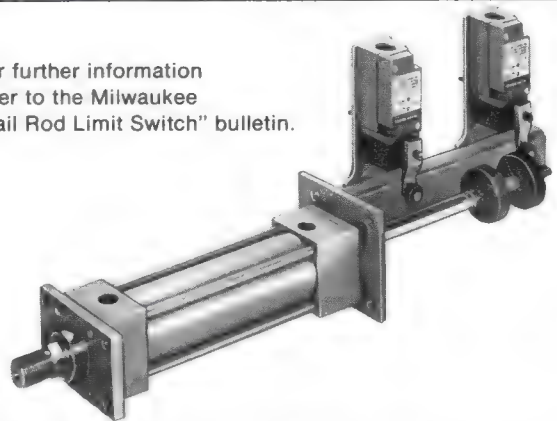
Water Service Cylinders

Milwaukee Series "H" cylinders can be used with water as an operating fluid with some standard modifications to the types of material and the manufacturing processes used. These modifications will include, at some additional cost, bronze piston, nickel plated end caps, a hard chrome plated cylinder barrel, and a chrome plated piston rod or stainless steel piston rod at extra cost. Due to the increased factors of corrosion, electrolysis, and mineral deposits acting within a water fitted cylinder, Milwaukee cannot warrant or make any guarantees other than a water service cylinder will be free of defects in workmanship or materials.

Tail Rod-Limit Switch Cylinder

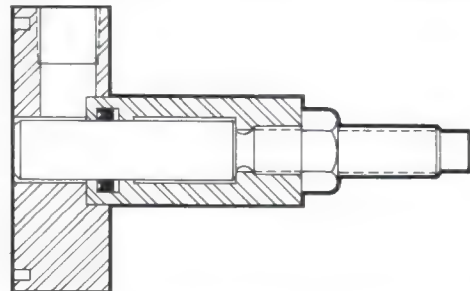
This unique design incorporates a standard Milwaukee series "H" double rod end cylinder with a limit switch "actuator accessory". Primarily this design is to be used on 1½ thru 2½" bore cylinders of 12" or less stroke, but can be adapted to larger bore sizes upon request.

For further information refer to the Milwaukee "Tail Rod Limit Switch" bulletin.



Adjustable Stroke Cylinders

When a cylinder application requires stroke adjustment Milwaukee offers a number of designs, the most common of which is illustrated below. This particular design is externally adjustable incorporating a threaded rod (of piston rod quality) with the standard hydraulic rod end multiple lip vee seal and bushing design. This provides a proven-effective high and low pressure seal affording maximum sealing on the stroke adjustment rod.



Further information concerning design limitations, cushioning, or alternate designs can be obtained by contacting the factory.

Design options

Modifications

PORTS

Standard Ports

The Milwaukee Series "H" cylinders are manufactured as standard, with NPTF tapered pipe thread ports of the largest size that will fit in both the rod and blind ends of a given bore size. Upon request extra ports can be provided on the sides of the end caps not occupied by mountings or cushion adjusters.

Oversize Ports

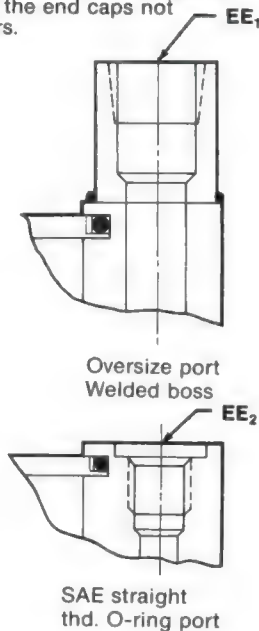
On most bore sizes, welded bosses may be provided for oversize NPTF ports. These bosses protrude from the sides of the end caps. For information as to the boss height, in relation to your bore and port requirements, contact your local Milwaukee Representative. Also special end caps can be provided, at additional cost, which are heavier so that oversize ports can be accommodated without the use of a welded boss.

Straight Thread Ports

On request Milwaukee will furnish an S.A.E. straight thread o-ring port with its Series "H" cylinders. In addition to the standard oversize NPTF ports welded bosses may also be used for oversize S.A.E. straight thread o-ring ports. For further information on oversize S.A.E. ports contact the factory.

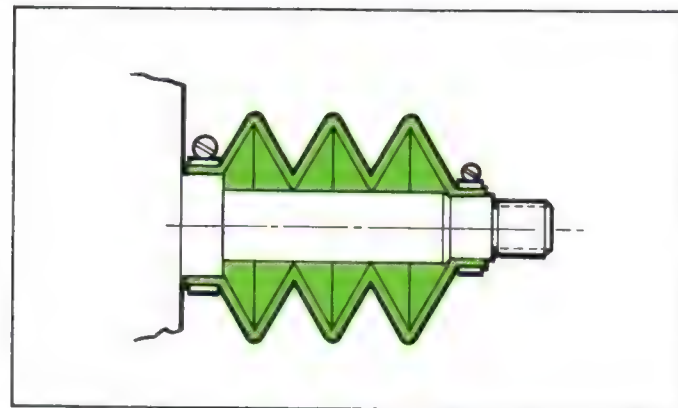
Note:

Flange and manifold style ports are available from Milwaukee at a slightly additional charge.



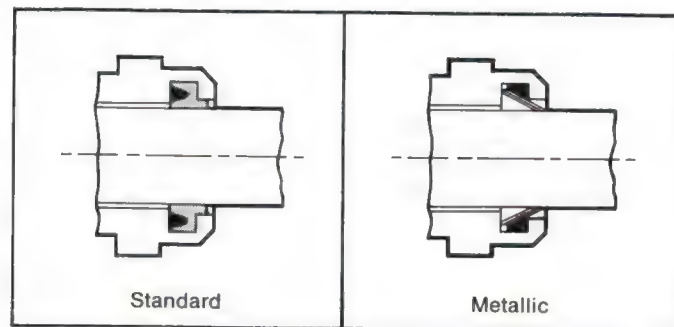
Rod Boots

When cylinders are used in areas of high contamination or where contaminants have an air hardening property the exposed piston rod should be covered with a rod boot to protect the rod bearing and seals. A rod boot is simply a collapsible cover used for such an application. It is of sewn construction made from a neoprene coated fabric. The rod boots are impervious to oil, grease, and water. They will operate effectively from 0 degrees F to +200 degrees F without cracking.



Metallic Rod Wipers

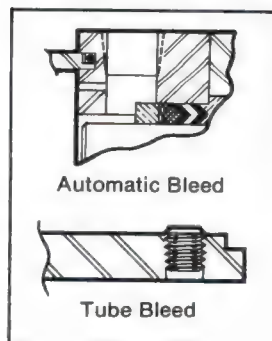
Metallic rod wipers will be supplied in place of the standard synthetic rubber wiper when specified at the time of order. This type of seal is recommended for applications where contaminants would tend to cling to the rod and damage a standard synthetic rubber rod wiper.



BORE	STD. NPTF PORT EE	OVER-SIZE NPTF PORT EE ₁	SAE STRAIGHT O-RING PORT	
			EE ₂	SAE STR. THD. SERIES
1½	½	¾	#10	7/8-14
2	½	¾	#10	7/8-14
2½	½	¾	#10	7/8-14
3¼	¾	1	#12	1½-12
4	¾	1	#12	1½-12
5	¾	1	#12	1½-12
6	1	1¼	#16	1½-12
7	1¼	1½	#20	1½-12
8	1½	2	#24	1½-12
10	2	2½	#24	1½-12
12	2½	3	#32	2½-12

Bleeder Ports

Bleeder ports are not regularly furnished with the Milwaukee Series "H" cylinder. Automatic air bleeds are regularly furnished on non-cushion cylinders. Bleeder ports are available upon request at a nominal extra charge. They will be placed on the cylinder barrel at either end and can be easily rotated into the correct position.



4-BOLT FLANGE PORTS HEAVY DUTY HYDRAULIC CYLINDERS

Bore	Rod Dia.	Nominal Flange Size (in.)
3.25	1.38	.75
	1.75	.75
	2.00	.75
4.00	1.75	.75
	2.00	.75
	2.50	.75
	2.50	.75
5.00	2.00	.75
	2.50	.75
	3.00	.75
	3.50	.75

Bore	Rod Dia.	Nominal Flange Size (in.)
6.00	2.50	1.00
	3.00	1.00
	3.50	1.00
	4.00	1.00
7.00	3.00	1.25
	3.50	1.25
	4.00	1.25
	4.50	1.25
	5.00	1.25
	5.50	1.25
8.00	3.50	1.50
	4.00	1.50
	4.50	1.50
	5.00	1.50
	5.50	1.50

NOTE: Some flange overhang will occur on heads or caps in most cylinder designs. Overhang may interfere with some end mountings.

Engineering Data

Stop Tube

Stop tubes are used to maintain bearing pressure within acceptable limits and are recommended on cylinders with long strokes or poorly guided rods.

The stop tube is a spacer between the rod end cap and the piston, which provides separation between the piston and the rod bearing. This separation reduces the moment forces developed between the rod bearing and piston when the rod is extended.

To determine if stop tube is necessary for your cylinder requirements you have to solve for "K" (refer to table 4). If your required cylinder has a "K" dimension in excess of 40 inches, stop tube is required. For each 10 inch increment or fraction thereof in excess of 40 inches, one inch of stop tube is recommended. When stop tube is required the overall length of the cylinder will be increased by the length of the stop tube to be used.

To Determine "K" (refer to table #4)

*note: W = the rod stick out (refer to pages 7 thru 15)

Cylinder #1, #4, #8 - from Table 4

$$K = 4L = 4 (\text{stroke} + W^*)$$

Cylinder #2 - from Table 4

$$K = L = (CA \text{ or } CE) + XG + \text{Stroke}$$

note: CA = rod eye dimension page 23

CE = rod clevis dimension page 23

XG = Mounting dimension page 13

Cylinder #3 - from Table 4

$$K = L = W^* + \text{Stroke}$$

Cylinder #5 - from Table 4

$$K = L = (CA \text{ or } CE) + XC + (2 \times \text{Stroke})$$

note: CA = rod eye dimension page 23

CE = rod clevis dimension page 23

XC = Mounting dimension page 13

Cylinder #6 - from Table 4

$$K = L = (CA \text{ or } CE) + XJ + (2 \times \text{Stroke})$$

note: CA = rod eye dimension page 23

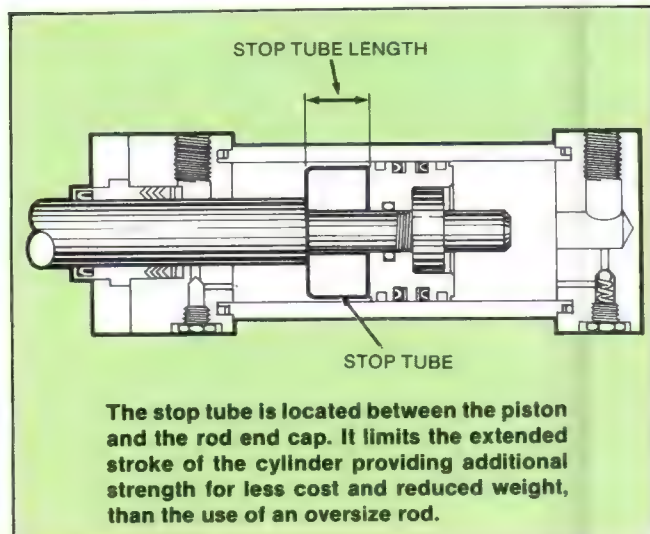
CE = rod clevis dimension page 23

XJ = Mounting dimension page 13

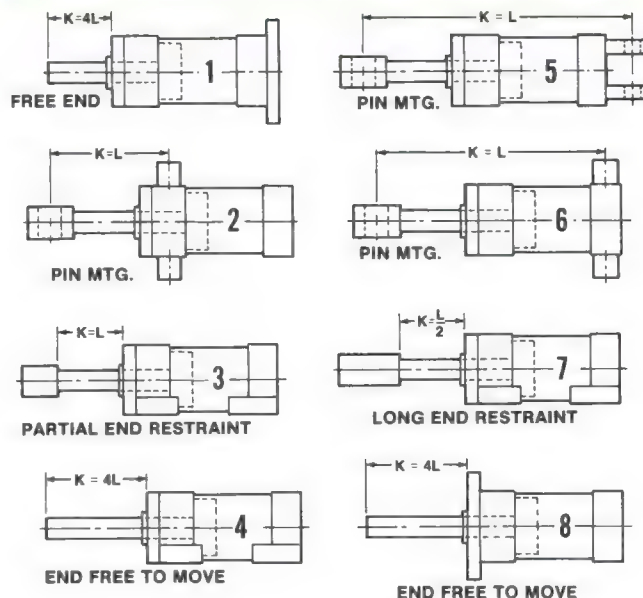
Cylinder #7 - from Table 4

$$K = L/2 = (W^* + \text{Stroke})/2$$

NOTE: Stop tube length must be added to "K" factor before making final selection of rod size. This is primarily true in No. 5 long stroke applications.



STROKE TO MOUNTING RELATIONSHIP
TABLE 4 — ALL RODS IN EXTENDED POSITION



When mounting long stroke cylinders care should be taken to assure cylinder alignment over the entire length of stroke. The use of external guides or swivel bushings is recommended to reduce side load conditions and prolong the cylinders service life.

THRUST FORCE In. Lbs.	TABLE 5 — VALUE OF "K" IN INCHES														
	PISTON ROD DIAMETER														
	5/8"	1"	1 1/8"	1 1/4"	1 1/2"	1 3/4"	2"	2 1/4"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	5 1/2"
400	35	84	134												
700	30	68	119												
1,000	26	60	105	156	190										
1,400	24	54	93	144	175	244	308								
1,800	23	48	84	127	160	230	294	366							
2,400	18	45	75	114	145	214	281	347							
3,200	16	40	68	103	131	196	262	329	398						
4,000	12	38	63	93	119	174	240	310	373	446					
5,000	9	36	60	87	112	163	225	289	359	426					
6,000		30	56	82	102	152	209	274	342	411	476				
8,000		25	51	76	93	136	186	244	310	375	448				
10,000		21	45	70	89	125	172	221	279	349	412				
12,000		17	41	64	85	117	155	210	270	326	388	455			
16,000			35	57	75	110	141	188	233	291	350	421			
20,000			28	52	66	103	136	173	218	270	325	385			
30,000				39	56	87	120	156	190	232	285	330			
40,000				24	43	75	108	142	177	210	248	293			
50,000					30	66	97	131	165	201	234	268	408		
60,000						57	88	119	154	190	226	256	384		
80,000							36	71	104	136	170	204	240	336	
100,000								56	91	120	154	199	224	324	
120,000									45	76	108	146	174	207	313
140,000										64	98	129	162	194	301
160,000											47	87	118	149	182
200,000												65	98	131	160
250,000													72	109	143
300,000														85	120
350,000															53
400,000															72
500,000															152
600,000															114
700,000															70

Engineering Data

Rod Size Selection

"Milwaukee" Hydraulic Cylinders incorporate a high strength, surface hardened rod. Standard rod sizes are generally suitable for most applications, however, on long stroke or high thrust applications, the selection of minimum rod size should be checked using the following steps:

1. Knowing bore size, stroke, and push thrust (refer to Table No. 7 below), determine the overall length between mounting points, Table 1, pages 7-15. Equate determined overall length to "L".
2. Select from Table 2, pages 7-15, the type mounting being used and determine the equivalent length dimension "K". (Refer to page 18.)
3. Refer to Table 5, page 18 and using thrust load and developed "K" dimension, select rod size.
4. If oversize rod is required, re-check overall length dimensions as determined in step No. 1. There will be a slight change which generally will not affect the "Size Determination" calculations, but must be considered in the cylinder installation.

TABLE 6 — DEDUCTIONS FOR PULL STROKE FORCE AND DISPLACEMENT

Rod Size	Rod Area Sq. In.	ROD DIAMETER FORCE IN POUNDS FOR VARIOUS LINE PRESSURES							DISPLACEMENT Per Inch of Stroke	
		500	750	1000	1250	1500	2000	3000	Cu. Inch	Gallons
5/8	.307	154	230	307	384	461	614	921	.307	.0013
1	.785	393	589	785	981	1178	1570	2355	.785	.0034
1 1/8	1.485	743	1114	1485	1856	2228	2970	4455	1.485	.0064
1 1/4	2.405	1203	1804	2405	3006	3608	4810	7215	2.405	.0104
2	3.142	1571	2357	3142	3928	4713	6284	9426	3.142	.0136
2 1/2	4.909	2455	3682	4909	6137	7364	9818	14,727	4.909	.0213
3	7.069	3535	5302	7069	8836	10,604	14,138	21,207	7.069	.0306
3 1/2	9.621	4811	7216	9621	12,026	14,432	19,242	28,863	9.621	.0416
4	12.566	6283	9425	12,566	15,708	18,849	25,132	37,698	12.566	.0544
4 1/2	15.904	7952	11,928	15,904	19,880	23,856	31,808	47,712	15.904	.0688
5	19.635	9818	14,726	19,635	24,544	29,452	39,270	58,905	19.635	.0850
5 1/2	23.758	11,879	17,819	23,758	29,698	35,637	47,516	71,274	23.758	.1028

NOTE:

To determine cylinder pull stroke force or displacement, deduct force or displacement corresponding to rod size in Table 6 from force or displacement corresponding to bore size shown in Table 7.

1 gallon = 231 Cu. In.
Area of Circle = .7854 d²

Piston Speed (In./Min.) = $\frac{\text{Pressure Source Delivery (GPM)}}{\text{Cylinder Displacement (Gal./In.)}}$

PIPING:

All pipes should be free from dirt, scale, rust, and threads de-burred. Seamless steel tubing makes an installation superior to piping as it is cleaner and leakproof.

TABLE 7 — THRUST FORCE AND DISPLACEMENT

Bore Size	Piston Area Sq. In.	CYLINDER THRUST FORCE IN POUNDS FOR VARIOUS LINE PRESSURES							DISPLACEMENT Per Inch of Stroke	
		500	750	1000	1250	1500	2000	3000	Cu. Inch	Gallons
1 1/2	1.767	884	1,325	1,767	2,209	2,650	3,534	5,301	1.767	.00765
2	3.142	1,571	2,357	3,142	3,928	4,713	6,284	9,426	3.142	.0136
2 1/2	4.909	2,455	3,682	4,909	6,137	7,364	9,818	14,727	4.909	.0213
3 1/4	8.296	4,148	6,222	8,296	10,370	12,444	16,592	24,888	8.296	.0359
4	12.566	6,283	9,425	12,566	15,708	18,849	25,132	37,698	12.566	.0544
5	19.635	9,818	14,726	19,635	24,544	29,452	39,270	58,905	19.635	.0850
6	28.274	14,137	21,206	28,274	35,342	42,411	56,548	84,822	28.274	.1224
7	38.485	19,242	28,864	38,485	48,106	57,727	76,970	115,455	38.485	.1666
8	50.265	25,133	37,699	50,265	62,832	75,398	100,530	150,795	50.265	.2176
10	78.54	39,270	58,905	78,540	98,175	117,810	157,080	235,620	78.54	.3400
12	113.10	56,550	84,825	113,100	141,375	169,650	226,200	339,300	113.10	.4896

Installation and Maintenance Notes

STORAGE

Often times cylinders are delivered before a customer is prepared to install them and must be stored for a period of time. When storage is required the following procedure should be employed:

1. Select an area indoors for storage, which has a dry and non-corrosive atmosphere. Take caution to protect the cylinder from both internal and external corrosion.
2. Cylinders to be stored should be kept in a verticle position (piston rod up) whenever possible.
3. Port protector plugs should be kept in the cylinder ports until the time of installation.

INSTALLATION

General Information

1. Cleanliness—the most important consideration when installing the cylinder. When cylinders are shipped from Milwaukee the ports are securely plugged with plastic plugs, which should not be removed until the piping is to be installed. All piping should be thoroughly clean to include the removal of all threading and flaring burrs or chips before making the connection to the cylinder ports. One chip can cause premature failure of the cylinder or other hydraulic system components.
2. Alignment. Improper alignment will result in excessive cylinder wear. Check to assure rod alignment between the cylinder and its mating component on your machine in both the extended and retracted positions.
3. Environment. Cylinders operating in areas where there is weld splatter, fast drying chemicals, paint, excessive heat or other hazardous conditions, should have covers or shields to prevent damage to the rod and rod seals.
4. Bleeding. Air within the cylinder or the system will cause erratic operation of the cylinder. Milwaukee cylinders generally do not require bleed ports if the cylinder ports are mounted in an up-right position. Several full strokes of the cylinder will purge air from the cylinder into the circuit piping where it can be bled off. Bleeds are available in the tube for applications where the cylinder is the high point of the circuit or where the cylinder does not complete a full stroke during its normal cycle.

Mounting Recommendations

1. Foot Mounted Cylinders.
The use of high strength alloy steel mounting bolts 1/16" smaller than the hole size is recommended. After final alignment foot mounted cylinders should be dowel pinned in place.
2. Trunnion Mounted Cylinders.
Lubricated pillow blocks, designed for close tolerance applications should be used. It is important to rigidly mount and align the pillow blocks so that the trunnion pins will not be subjected to any extreme bending moments. The rod end should be pivoted with the pivot pin in line and parallel to the axis of the trunnion pins.
3. Flush Mount Cylinders.
The use of high strength alloy steel mounting bolts is recommended. Shear keys should be used to reduce the stress on the mounting bolts created by the normal push and pull forces created by the cylinder cycle.
4. Flange Mount Cylinders.
The controlled diameter rod bushing extension can be used as a pilot to locate the flange mount. Dowel pins should be used after the cylinder is mounted and aligned to prevent shifting.
5. Clevis Mount Cylinders.
This type of cylinder must be pivoted at both ends and the pins must be in line and parallel to each other. After the cylinder is mounted the customer should check to assure that the cylinder is free to swing through its working arc without interference from other machined parts.

CYLINDER TROUBLE SHOOTING

1. External leakage —
If leakage occurs between the end cap and barrel check the tie rod torque. If the torque is correct then replace the barrel seal. When leakage occurs in the rod bushing area the rod seals should be replaced. If leakage continues or reoccurs in short period of operation check items 2 thru 5.
2. Cylinder misalignment —
Side load is a common problem which occurs when the cylinder application does not allow the piston rod to work in line during the extend and retract motions of the cylinder. Evidence of this is excessive seal failure, bushing wear, or galling of the piston rod. Often bending of the piston rod or complete failure (breakage) of the rod occurs.
3. Contamination on the piston rod —
Dirt and other material is often picked up when the piston rod is extended. When the rod is retracted in an excessively dirty application it often carries the dirt back into the rod seal cavity of the cylinder causing damage to the seals. With a

slight modification of the cylinder rod end, a rod boot can be added to protect the rod bushing and seals for most applications.

4. Bad mountings —
Due to wear of pivot pins or mounting bolts working loose a cylinder may have side load even though the rod was in line when the cylinder was first installed. All cylinder mountings should be checked periodically.
5. Damaged piston rod —
An extended piston rod can be damaged by the impact of a hard object which could burr the rod. If this occurs the rod should be checked immediately to prevent seal damage.
6. Internal leakage —
Inside the cylinder leakage past the piston seals can cause sluggish movement or settling of the cylinder under load conditions. This occurs due to leakage of worn piston seals or rings.
7. Creeping cylinder —
When a cylinder is stopped in midstroke and it creeps check for internal leakage. Creeping can also be caused by a worn control valve and this should be checked even if the cylinder is found to have internal leakage.
8. Erratic operation —
When a cylinder is erratic or sluggish in operation this may be caused by a number of problems. The most common cause of sluggish operation is air in the system. Internal leakage could also be a cause. If the system starts out sluggishly and as it warms speeds up the oil may be of too high a viscosity. The whole system should be checked for worn components if after these checks the cylinder is still operating in a sluggish manner.

CYLINDER MAINTENANCE

Rod Seal Replacement

When changing rod seals extend the piston rod 3" or more if possible being sure to support the rod at all times. Remove the retainer plate screws (if tie rod nuts have to be removed refer to the nut torque specification on this page when re-assembling the cylinder), retainer plate and outer bushing. Using an eye hook or thin screwdriver pry the vees from the end cap cavity (if low pressure air is applied to the rod end port this will help to force the vees from the cavity). The new set of vees should be assembled into the cavity separately and lubed with the soft vee in the center. Replace the rod wiper in the bushing and reassemble the cylinder.

Piston Seal Replacement

When changing piston seals extend the piston rod 3" or more, if possible, being sure to support the piston rod and the piston at all times. Remove the tie rod nuts, blind end cap, the barrel and then the piston seals. A light grease, compatible with the system fluid, should be used on the rings and block vee seals for smooth assembly. Install the block vee piston seals, scarf cutting only the back-up washers. Then install the cast iron rings with the joints in opposite directions. To reassemble start the piston into the tube compressing the cast iron rings using twine or a ring compressor. When the piston block vee seal is to the edge of the barrel, use a thin rounded blade to start the lip of the block vee, making sure the entire lip is started before moving the piston further into the tube.

*Note:

When a cylinder has been disassembled this far the barrel seals should at least be inspected if not replaced.

Barrel Seal Replacement

When replacing barrel seals use the same method of disassembling the cylinder as used when replacing piston seals. The barrel seal consists of a backup washer and o-ring, which is assembled on the first step of both ends of the tube with the backup washer going on first. The outer diameter of the tube groove on the end caps must be checked for nicks or burrs and then greased. Position the end caps squarely on the tube (check to make sure port location is correct) and firmly force or tap the end cap over the tube until it bottoms. Check to make sure the o-ring did not shear and then finish assembling the cylinder.

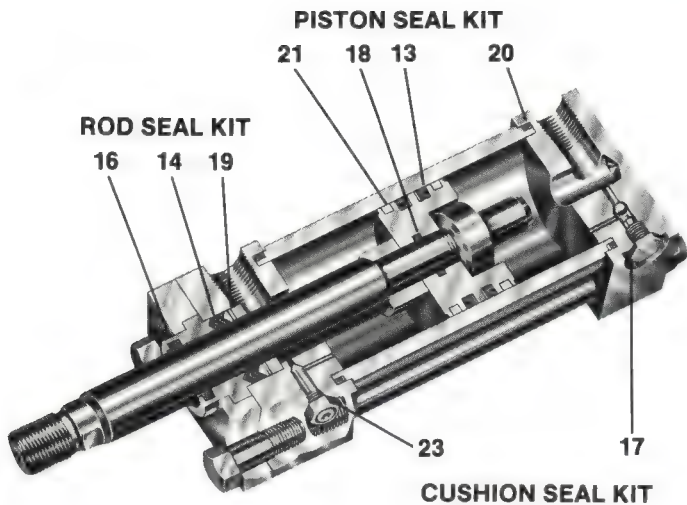
Nut Torque Specifications

When it is necessary to remove the tie rod nuts on a cylinder they must be reassembled to the torque specification given below. To prevent the tie rods from twisting when tightened use a vice grips or locking clamp. Note that the torque specification is based on lubricated threads.

NUT TORQUE SPECIFICATIONS

Cylinder Bore	1½	2-2½	3¼-4	5	6	7	8	10	12
TORQUE	25	45	125	300	400	600	900	2500	3700
FT LBS									

Seal Kits



How to Order Complete Seal Kits

When ordering complete seal kits specify the following information on your order:

1. The serial number of the cylinder the seals will be used on.
2. The bore and rod size.
3. If the cylinder is cushioned.

To eliminate untimely delays in the handling of your order please use the seal kit code as shown in the example below:

Example:

Buna-N Kit No. XXXXX-0-40
-cylinder code number
(refer to page 6-15)

Viton Kit No. XXXXX-1-40
 -cylinder code number
 (refer to page 6-15)

How to Order Partial Seal Kits

Refer to the picture at left to determine which partial seal kit you require and then select the appropriate kit number from the tables below. Standard Series "H" cylinders contain Buna-N seals. Viton seals are used in applications where temperatures are in excess of +250 degrees F.

STD. ROD DIA.	ROD SEAL KIT	
	BUNA-N	VITON
5/8	00151-0-41	00151-1-41
1	00152-0-41	00152-1-41
1 3/8	01511-0-41	01511-1-41
1 3/4	01522-0-41	01522-1-41
2	01532-0-41	01532-1-41
2 1/2	01542-0-41	01542-1-41
3	01552-0-41	01552-1-41
3 1/2	01553-0-41	01553-1-41
4	01563-0-41	01563-1-41
4 1/2	01573-0-41	01573-1-41
5	01574-0-41	01574-1-41
5 1/2	01584-0-41	01584-1-41

BORE SIZE	PISTON SEAL KIT	
	BUNA-N	VITON
1½	00151-0-42	00151-1-42
2	01510-0-42	01510-1-42
2½	01520-0-42	01520-1-42
3¼	01530-0-42	01530-1-42
4	01540-0-42	01540-1-42
5	01550-0-42	01550-1-42
6	01560-0-42	01560-1-42
7	01570-0-42	01570-1-42
8	01580-0-42	01580-1-42
10	15100-0-42	15100-1-42
12	15120-0-42	15120-1-42

BORE SIZE	CUSHION SEAL KIT	
	BUNA-N	VITON
1½	00151-0-51	00151-1-51
2-5	01510-0-51	01510-1-51
6-12	01560-0-51	01560-1-51

FLUIDS

Hydraulic fluid is much more than the theoretician's incompressible medium. It heats, cools, lubricates and sometimes corrodes mechanical components, picks up and releases gases, and sweeps sludge into supposedly free clearances. The fluid is just as important as any other part of the hydraulic system. In fact, a major portion of hydraulic problems stem from the use of improper types of fluids or fluids containing dirt and other contaminants.

To understand the fluids used in today's industry, you have to divide them into two general areas: petroleum fluids and fire resistant fluids. These in turn break down into a number of different types with different properties. Not all fluids are compatible with the standard seal combinations offered by cylinder manufacturers.

The chart shows a small sample of the fluids available and the seals with which they are compatible. Specific information on seal compatibility is available from either the fluid supplier or the component manufacturer.

The chart is for general information and should not be taken as warranty or representation for which legal responsibility is assumed. The chart and the information on this page are offered only for your convenience, consideration, investigation, and verification.

SEAL COMPATIBILITY WITH COMMON FLUIDS

Fluid Name	Military Specification	Mfg. No.*	Trade Name/Number	Compatibility**			
				Buna-N	Poly-urethane	EP	Viton Fluoro-carbon
Water Glycol	MIL-H22072	1	Houghto-Safe 600 Series	R	U	R	S
		1	Houghto-Safe 500 Series	R	U	R	—
		1	Houghto-Safe 271 Series	R	U	R	S
		4	Ucon Hydrolube	R	U	R	R
		5	Celluguard	R	U	R	R
Water Oil/Emulsion		1	Houghto-Safe 5040	R	U	U	R
		3	Gulf FR	R	R	U	R
Water Soluble Oil		—	—	R	—	R	—
Water Fresh		—	—	R	U	R	S
Water Salt		—	—	R	U	R	S
Phosphate Ester	MIL-19547B	1	Houghto-Safe 1000 Series	U	—	R	R
		1	Houghto-Safe 1120	U	U	R	R
		8	Pyrogard 42, 43, 53, 55	U	U	R	R
		2	Skydrol 500 Type 2	U	U	R	U
		2	Skydrol 7000 Type 2	U	U	R	U
Diester	MIL-H-7808	—	Lube Oil Aircraft	S	U	U	S
Silicate Ester	MIL-H-8446B	7	Brayco 846	S	R	U	R
Kerosene		—	—	R	R	U	R
Jet Fuel	MIL-J-5624	—	JP-3,4,5 (RP-1)	R	S	U	R
Diesel Fuel		—	—	R	M	U	R
Gasoline		—	—	R	S	U	R
Petroleum Base	MIL-H-6083	—	Preservative Oil	R	R	U	R
	MIL-H-5606	—	Aircraft Hyd. Fluid	R	S	U	R
High Water Base 95-5		1	Hydrolubic 120-B	S	R	S	S

- *1. E. F. Houghton
- *2. Monsanto
- *3. Gulf
- *4. Union Carbide & Chemical
- *5. Stauffer Chemical
- *6. Standard Oil (Ortho Chemical)
- *7. Bray Oil — Royal Lubricant
- *8. Mobil Oil

- **R** = recommended
****S** = satisfactory
****M** = marginal
****U** = unsatisfactory
****—** = insufficient data

SEALS

Buna-N Seal

This type of seal of excellent with petroleum products. The seal is rated for a temperature range from -30°F to $+250^{\circ}\text{F}$, but when used for low temperatures, it is necessary to sacrifice some low temperature resistance. It is a superior material for compression set, cold flow, tear and abrasion resistance. This seal is generally recommended for petroleum, water, and water-glycol.

Polyurethane Seal

The polyurethane seal provides excellent mechanical and physical properties. Recommend for hydraulic service in petroleum based oils where resistance to extrusion and abrasion is required. Temperature range is -40°F to 180°F .

How to Order

Series "H" Cylinders

Standard Series "H" Cylinders can be completely and accurately described by a model number consisting of coded symbols. If your requirements are completely standard, select the symbols from page 23 that represent your cylinder and place them in the sequence indicated by the example. Use of the cylinder code will eliminate untimely delays in handling your order. Be sure to include with your order, all of the information requested in the applications data area.

General Order Data (Covered by the cylinder code)

1. Bore & Rod size or the cylinder code: (refer to page 6-15)
2. Mounting Style: (refer to page 6-15)
3. Rod End Style: (refer to page 2)
4. Cushion Requirements
5. Length of Stroke

Note: Duplicate cylinders can be ordered by giving the serial number from the nameplate of the original cylinder. Factory records supply a quick, positive identification.

Replacement Seals or Cylinder Parts

For replacement seals or cylinder parts, the serial number of your cylinder, the cylinder code and the item number of the part you require (page 23) should appear on your order. To order entire seal kits for your cylinder simply specify the serial number and the cylinder order number from page 23 on your request for service parts.

Applications Data

1. Port Requirements: refer to page 17.
2. Operating Fluid or Medium: Series "H" cylinders are equipped with seals for use with hydraulic oil. If other than a quality grade hydraulic oil will be used specify the type of fluid in your order.
3. Temperature Range: Series "H" hydraulic cylinders contain seals of Nitrile (Buna-N) suitable to -30 degrees F to $+250$ degrees F. Specify your operating temperature if your application does not fall within this temperature range.
4. Operating Pressure: Series "H" cylinders are rated for 3000 PSI. If your requirements are in excess of the rated pressure describe your application in your order.
5. Accessories: Specify any accessories you require using the part numbers given on page 23.
6. Special Requirements: If you require special seals, rod material, stop tube, center support, adjustable stroke, or any other special requirements not covered, specify in detail on your order.

Ethylene Propylene

This seal is excellent when used with Skydrol 500 and Phosphate Ester fluids. The seal is rated for a temperature range from -65°F to $+350^{\circ}\text{F}$. This seal is generally recommended for phosphate ester, steam (to 400°F), water and ketones.

Viton Seal

Viton seals are compatible with a wide range of fluids. This seal is rated for a temperature range from -20°F to $+350^{\circ}\text{F}$. This seal is generally recommended for petroleum, silicate ester, diester, halogenated hydrocarbons and most phosphate esters.

Retainer Plate Capscrew Torques

Retainer Plate Capscrew Torques
All Rod Sizes — Models H21 and H31

BORE	RETAINER	TORQUE (LBS-FT.)
1½		34
2		84
2½		84
3¼	Std	75
4	Std	75
5	Std	114
	Heavy	220
6	Std	220
	Heavy	280
7	Std	220
	Heavy	366
8	Std	366
	Heavy	585

Retainer Plate Capscrew Torques
Models H22, H32, H61 and H73

BORE	ROD	TORQUE (LBS-FT.)
1½	5/8	10
2	1	10
2½	1	10
	1⅜	10
3¼	All	10
4	All	10
5	All	10
6	2½	10
	3	30
	3½	30
	4	30
7	All	30
8	3½-5	30
	5½	50
10	4½	30
	5	30
10	5½	50
12	All	50

WARRANTY

Seller warrants the goods sold hereunder to be free from defects in material and workmanship for a period of twelve months after date of shipment from Seller's plant. If the goods are in accordance with or in reference to an engineering drawing specified by or furnished to the customer, the specifications and information on the drawing shall be applicable in determining such correct use, operation and application.

When claiming a breach of the above warranty, Buyers must notify Sellers promptly in writing whereupon Seller will either examine the goods at their site, or issue shipping instructions for return to Seller.

When any goods sold hereunder are proved not as warranted, Seller's sole obligation under this warranty shall be to repair or

replace the goods, not including installation or any other charges, at its option, without charge to Buyer.

THIS WARRANTY COMPRISES SELLER'S SOLE AND ENTIRE WARRANTY OBLIGATION AND LIABILITY TO BUYER, IT'S CUSTOMERS AND ASSIGNS IN CONNECTION WITH GOODS SOLD HEREUNDER. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS ARE EXPRESSLY EXCLUDED.

CONSEQUENTIAL DAMAGES: In no event shall Seller be liable for consequential or special damages arising out of a delay in or failure of delivery, defects in material or workmanship, or arising out of a breach by Seller of any other term or obligation of Seller under this contract.

Cylinder Force and Speed

Hydraulic Cylinder Force

Table 7 on page 19 shows the thrust force developed by various bore diameters when working at various pressures. These figures do not include a factor covering a reduction in force due to seal or packing friction in the cylinder. This type of friction is estimated to affect the cylinder thrust force by 10%. Additional pressure must be developed by the pump not only to overcome frictional loss, but also flow losses in the circuitry. The engineer should realize that the useable pressure in the cylinder may be from 10% to 25% less than the pump and relief valve gauge reading.

Hydraulic Cylinder Speed

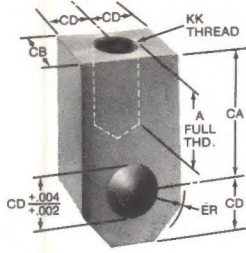
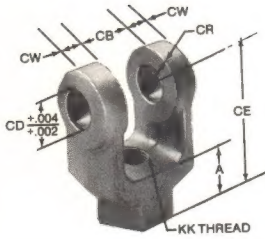
Figures shown in the body of this chart are cylinder rod travel speeds in inches per minute. The extension speeds represent the net piston area for the various rod diameters shown.

HYDRAULIC CYLINDER SPEEDS

Piston Dia.	Rod Dia.	1 GPM	3 GPM	5 GPM	8 GPM	12 GPM	15 GPM	20 GPM	25 GPM	30 GPM	40 GPM	50 GPM	75 GPM
1½	None	130	392	654	1034								
	5/8	158	476	792	1265								
	1	235	706	1176	1880								
2	None	73	221	368	588	883	1120						
	1	97	294	490	782	1175	1465						
	1¾	139	418	697	1115	1673	2090						
2½	None	47	131	235	376	565	675	940	1175				
	1	56	168	280	448	672	840	1120	1400				
	1¾	67	203	339	542	813	1015	1355	1695				
	1¾	92	277	463	740	1110	1385	1850	2310				
3¼	None	28	83	139	223	334	417	557	696	836	1115		
	1¾	34	102	170	271	407	510	680	850	1020	1360		
	1¾	39	118	196	313	472	588	784	980	1176	1568		
	2	44	134	224	358	537	672	896	1120	1344	1792		
4	None	18	55	92	147	220	276	368	460	552	736	920	
	1¾	22	68	113	182	273	339	452	565	678	904	1130	
	2	24	73	122	196	294	366	488	610	732	976	1220	
	2½	30	90	150	241	362	450	600	750	900	1200	1500	
5	None	12	35	58	94	141	174	232	290	348	464	580	870
	2	14	42	70	112	168	210	280	350	420	560	700	1050
	2½	16	47	78	125	188	235	315	390	470	630	780	1170
	3	18	55	92	147	220	275	365	460	550	730	920	1380
6	3½	22	66	111	178	266	333	444	555	665	888	1110	1665
	None	8	24	41	65	98	123	162	202	245	320	405	606
	2½	10	30	50	79	118	150	200	250	300	400	495	750
	3	11	33	54	87	130	165	206	270	325	435	545	810
	3½	12	37	62	99	148	185	245	310	370	495	615	830
7	4	15	44	73	117	176	220	295	365	440	585	735	1095
	None	6	18	30	48	72	90	120	150	180	240	300	450
	3	7	22	37	59	88	110	145	185	220	295	365	555
	3½	8	24	40	64	96	120	160	200	240	320	400	600
	4	9	27	45	71	107	135	180	225	270	360	445	675
	4½	10	31	51	82	122	153	205	255	305	410	515	765
	5	12	37	61	98	147	185	245	305	370	490	615	915
8	None	4	14	23	36	55	69	92	115	135	185	230	345
	3½	5½	17	28	45	68	85	115	140	170	230	285	420
	4	6	18	30	49	73	90	122	150	180	240	305	450
	4½	6½	20	33	53	80	100	135	165	200	265	335	495
	5	7½	22	38	60	90	114	150	185	225	300	375	555
	5½	8½	26	43	70	104	129	172	215	255	345	430	645
10	None	3	9	15	23	35	44	60	73	88	115	145	220
	4½	3½	11	18	29	44	55	75	92	111	150	185	275
	5	4	12	20	31	47	60	80	100	120	155	195	300
	5½	4½	13	21	34	50	63	84	105	132	165	210	315
	7	5½	17	29	46	69	87	115	145	174	230	285	435

Dimensional data

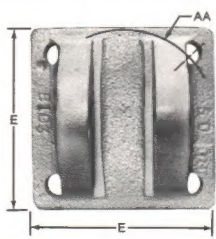
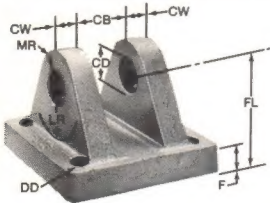
ACCESSORIES



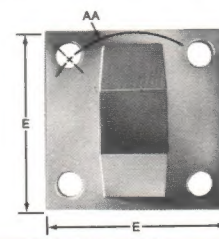
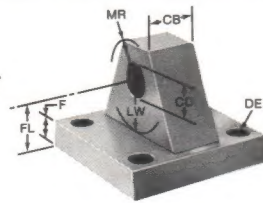
Note:

The rod clevis' and rod eyes are designed for use with the standard "Milwaukee" style No. 2 rod end. When ordering these accessories be sure to match the thread size of the style No. 2 rod end of the rod size you ordered to the thread size of the accessory you require.

ROD CLEVIS		ROD EYE		MAX. LOAD (TENSION) POUNDS	THD. SIZE KK	A	CA	CB	CD	CE	CR	CW	ER
PART NO.	CODE	PART NO.	CODE										
15-72-1001	C101	15-73-1001	C301	4380	7/16-20	3/4	1 1/2	3/4	1/2	1 1/2	1/2	1/2	9/16
15-72-1002	C102	15-73-1002	C302	12372	3/4-16	1 1/8	2 1/16	1 1/4	3/4	2 3/8	3/4	5/8	1 5/16
15-72-1003	C103	15-73-1003	C303	20433	1-14	1 5/8	2 13/16	1 1/2	1	3 1/8	1	3/4	1 1/8
15-72-1004	C104	15-73-1004	C304	30483	1 1/4-12	2	3 7/16	2	1 3/8	4 1/8	1 3/8	1	1 9/16
15-72-1005	C105	15-73-1005	C305	49479	1 1/2-12	2 1/4	4	2 1/2	1 3/4	4 1/2	1 5/8	1 1/4	1 7/8
15-72-1006	C106	15-73-1006	C306	70095	1 7/8-12	3	5	2 1/2	2	5 1/2	2	1 1/4	2
15-72-1007	C107	15-73-1007	C307	94248	2 1/4-12	3 1/2	5 13/16	3	2 1/2	6 1/2	2 3/8	1 1/2	2 1/2
15-72-1008	C108	15-73-1008	C308	121932	2 1/2-12	3 1/2	6 1/8	3	3	6 3/4	2 3/4	1 1/2	2 3/4
15-72-1009	C109	15-73-1009	C309	187908	3-12	4 1/2	7 5/8	4	3 1/2	8 1/2	3 1/2	2	3 1/2
15-72-1010	C110	15-73-1010	C310	268026	4-12	5 1/2	9 1/8	4 1/2	4	10	4	2 1/4	4



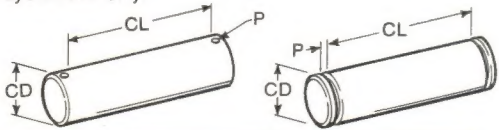
CLEVIS BRACKET



EYE BRACKET

CLEVIS BRACKET		EYE BRACKET		MAX. LOAD (TENSION) POUNDS*	MAXIMUM PRESSURE (PSI*)	AA	CB	CD	CW	THD. SIZE DD	DE	E	F	FL	LR	LW	MR
PART NO.	CODE	PART NO.	CODE														
15-74-2001	B101	15-75-2001	B401	7510	3000	2.3	3/4	1/2	1/2	3/8-24	1 3/32	2 1/2	3/8	1 1/8	1 3/16	1 1/16	1/2
15-74-2002	B122	15-75-2002	B422	20082	3000	2.9	1 1/4	3/4	5/8	1/2-20	1 7/32	3	5/8	1 7/8	1 1/16	1 1/4	3/4
15-74-2003	B102	15-75-2003	B402	20082	3000	3.6	1 1/4	3/4	5/8	1/2-20	1 7/32	3 1/2	5/8	1 7/8	1 5/16	1 3/16	3/4
15-74-2004	B103	15-75-2004	B403	27684	3000	4.6	1 1/2	1	3/4	5/8-18	2 1/32	4 1/2	3/4	2 1/4	1 3/8	1 3/8	1
15-74-2005	B104	15-75-2005	B404	20685	3000	5.4	2	1 1/8	1	5/8-18	2 1/32	5	7/8	3	1 7/8	1 7/8	1 3/8
15-74-2006	B105	15-75-2006	B405	31556	2435	7.0	2 1/2	1 3/4	1 1/4	7/8-14	2 29/32	6 1/2	7/8	3 3/8	2	2 1/32	1 5/8
15-74-2007	B106	15-75-2007	B406	35381	1671	8.1	2 1/2	2	1 1/4	1-14	1 1/32	7 1/2	1	3 1/2	2 1/16	2 1/16	2
15-74-2008	B107	15-75-2008	B407	34210	1299	9.3	3	2 1/2	1 1/2	1 1/8-12	1 5/32	8 1/2	1	4	2 5/8	2 29/32	2 3/8
15-74-2009	B108	15-75-2009	B408	34868	850	10.6	3	3	1 1/2	1 1/4-12	1 19/32	9 1/2	1	4 1/4	2 7/8	2 7/8	2 3/4

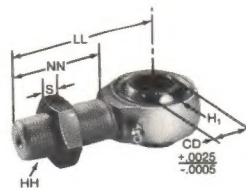
*Eye bracket only.



PIVOT PIN

- Pivot pins are furnished with clevis mounted (H-61) cylinders as standard.
- Pivot pins for 1 1/2" - 6" bore are furnished with cotter pins. Pivot pins for 7" bore thru 12" bore are furnished with snap rings.
- Pivot pins are not furnished as standard and must be ordered separately for use with accessories.

PIVOT PIN				
PART NO.	CODE	CD	CL	P
15-76-1001	P101	1/2	1 7/8	9/64
15-76-1002	P102	3/4	2 5/8	9/64
15-76-1003	P103	1	3 3/8	13/64
15-76-1004	P104	1 3/8	4 1/8	13/64
15-76-1005	P105	1 3/4	5 1/8	13/64
15-76-1006	P106	2	5 1/8	1 1/64
15-76-1007	P107	2 1/2	6 1/8	Groove width .086 to .091
15-76-1008	P108	3	6 3/16	Groove width .103 to .108
15-76-1009	P109	3 1/2	8 1/8	Groove width .120 to .125
15-76-1010	P110	4	9 1/8	Groove width .120 to .125



SPHERICAL ROD EYE

Note:
The spherical rod eye is used with Style 3 and 5 rod ends.



PART NUMBER	MAX. LOAD (TENSION) POUNDS	SPHERICAL ROD EYE						
		a ₁	CD	EW	H ₁	HH	LL	NN
HS-301	1665	12°	1/2	5/8	1 1/16	7/16-20	2 7/16	1 15/32
HS-302	7020	13 1/2°	3/4	7/8	2 29/32	3/4-16	2 27/32	1 23/32
HS-303	19050	14°	1 1/2	1 3/8	1 11/32	1-14	4 3/32	2 23/32

Cylinder Order Code — Model Number

FEATURE	DESCRIPTION	PAGE NO.	CODE NO.	EXAMPLE
DOUBLE ROD END		14	D	<p>1541 — 31 — 1 4 — 1 x 14³/₄</p>
CYLINDER CODE	REFER TABLE 1	7, 9, 11 13 & 15	—	
MOUNTING STYLE	MODEL NUMBER ONLY	6, 8, 10 12 & 14	—	
ROD END STYLE	CODE NUMBER	2	—	
CUSHIONS	NONE ROD END BLIND END BOTH ENDS	— — — —	1 2 3 4	
CYLINDER MODIFICATIONS	SPECIAL		S	
SEALS	BUNA (-30° TO 250° F) VITON (-15° TO 350° F) SPECIAL		1 2 S	
STROKE	SPECIFY IN INCHES INCLUDING FRACTIONAL REQUIREMENTS		—	

***NOTE:
USE "S" IF ANY SPECIAL DESIGN FEATURES OR
SEALS ARE REQUIRED. DESCRIBE IN DETAIL
ON YOUR ORDER.**

EXAMPLE: THE CODE FOR A HYDRAULIC CYLINDER 4" BORE, 2" ROD, STYLE NO. 1 ROD END, CUSHION BOTH ENDS STANDARD SEALS WITH A 14³/₄" STROKE IS 1541-14-1 x 14³/₄"

Standard Parts List

The diagram shows an exploded view of a hydraulic cylinder assembly. The components are numbered as follows:

- 1:** Piston rod
- 2:** Cylinder barrel
- 3:** Head end cap
- 4:** Cap end cap
- 5:** Rod bushing
- 6:** Retainer plate
- 7:** Piston
- 8:** Cushion plunger
- 9:** Cushion adj. needle
- 10:** Ball check retainer
- 11:** Ball check
- 12:** N/A
- 13:** Block Vee packing and backup washer for piston
- 14:** Rod vee ring set
- 15:** Rear bearing ring
- 16:** Rod wiper
- 17:** "O" ring seal for ball check retainer
- 18:** "O" ring seal for piston
- 19:** Wave spring
- 20:** Cylinder barrel "O" ring and backup washer
- 21:** C.I.P. standard ring
- 22:** Tie rod flex loc nut
- 23:** Teflon ring seal for cushion adj. needle
- 24:** Piston nut
- 25:** Jam nut for cushion adj. needle
- 26:** Tie rod
- 27:** Nylock cap screw

ITEM
NO.

DESCRIPTION

ITEM
NO.

DESCRIPTION

1

PISTON ROD

2

CYLINDER BARREL

3

HEAD END CAP

4

CAP END CAP

5

ROD BUSHING

6

RETAINER PLATE

7

PISTON

8

CUSHION PLUNGER

9

CUSHION ADJ.
NEEDLE

10

BALL CHECK
RETAINER

11

BALL CHECK

12

N/A

13

BLOCK VEE PACK-
ING AND BACKUP
WASHER FOR PISTON

14

ROD VEE RING SET

15

REAR BEARING RING

16

ROD WIPER

17

"O" RING SEAL
FOR BALL CHECK
RETAINER

18

"O" RING SEAL
FOR PISTON

19

WAVE SPRING

20

CYLINDER BARREL
"O" RING AND
BACKUP WASHER

21

C.I.P. STANDARD
RING

22

TIE ROD FLEX
LOC NUT

23

TEFLON RING SEAL
FOR CUSHION
ADJ. NEEDLE

24

PISTON NUT

25

JAM NUT FOR
CUSHION ADJ.
NEEDLE

26

TIE ROD

27

NYLOCK CAP
SCREW

Your Economy is in Our Quality



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